Papilio cresphontes

# FIELD BOOK OF INSECTS

WITH SPECIAL REFERENCE TO THOSE OF NORTHEASTERN UNITED STATES, AIMING TO ANSWER COMMON QUESTIONS

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*With about 800 Illustrations, Many in Color*

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The study of entomology is one of the most fascinating of pursuits. It takes its votaries into the treasure-houses of Nature, and explains some of the wonderful series of links which form the great chain of creation. It lays open before us another world, of which we have been hitherto unconscious, and shows us that the tiniest insect, so small perhaps that the unaided eye can scarcely see it, has its work to do in the world, and does it.

Rev. J. G. Wood.

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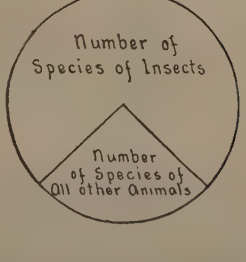
| | |
|---|---|
| Insects | 400,000 |
| Mollusks | 50,000 |
| Fishes | 15,000 |
| Birds | 13,000 |
| Crustacea | 8,000 |
| Worms | 7,000 |
| Arachnida | 5,000 |
| Protozoa | 5,000 |
| Reptiles & Amphibians | 5,000 |
| Mammals | 4,500 |




The Estimated Number of Described Living Species of Animals

## INTRODUCTION

**Why?** Ten years ago I felt sure that there was little excuse for additional general entomologies. The market seemed full of popular, semi-popular and unpopular books, each apparently attempting the impossible—the covering of a boundless field. Since then a hundred, or more, new works on the subject have appeared and lo! here is still another because, in the meantime, it has been my privilege to come in rather close contact with the laity, having been the official answerer of all sorts of questions from "How much is a moth worth?" to "Why are bedbugs?" I take this opportunity of taking up some of the intermediate points.

**What?** When the publishers of this series spoke about a Field Book of Insects, to be a companion to the excellent books already published, we began to deal with the arithmetic of large numbers. There are, for example, approximately 15,000 species of insects to be found within fifty miles of New York City; more than 2,000 of these are either moths or butterflies. A book to enable the student to recognize all the insects of even this limited region would have to be as large as one for the birds for the whole world. The accompanying diagrams may win some sympathy for entomologists and at the same time indicate the inexhaustible field for study offered by insects. However, only a small portion of these thousands are usually noticed by the layman or, outside of his speciality, by the average amateur, and generally the interest is not so much in knowing the specific name as in learning the general group to which the insect belongs and what it does. This constitutes a general knowledge of insects; to go further, in most groups, one must become a specialist. This book refers, by specific name, to about 1400 different kinds of insects inhabiting the United States and nearly 600 of these are illustrated by one or more figures. If the selections were as wisely made as we hope they were, the non-specialist should be able, by its aid, to recognize, at least in a general way,

| | *Families* | *Genera* | *Species* |
|---|---|---|---|
| Thysanura | 2 | 18 | 41 |
| Ephemerida | 1 | 13 | 29 |
| Plecoptera | 1 | 14 | 25 |
| Mallophaga | 4 | 14 | 100 |
| Isoptera | 1 | 1 | 1 |
| Corrodentia | 1 | 17 | 39 |
| Platyptera | 1 | 3 | 9 |
| Neuroptera | 6 | 22 | 41 |
| Mecoptera | 1 | 4 | 11 |
| Trichoptera | 7 | 30 | 56 |
| Odonata | 3 | 43 | 109 |
| Thysanoptera | 1 | 6 | 12 |
| Parasitica | 1 | 3 | 13 |
| Homoptera | 11 | 149 | 479 |
| Hemiptera | 23 | 205 | 504 |
| Dermoptera | 1 | 5 | 5 |
| Orthoptera | 6 | 58 | 154 |
| Coleoptera | 77 | 1,079 | 3,092 |
| Lepidoptera | 48 | 715 | 2,120 |
| Hymenoptera | 81 | 541 | 1,980 |
| Siphonoptera | 1 | 4 | 4 |
| Diptera | 53 | 542 | 1,661 |
| Totals | 331 | 3,486 | 10,385 |

The Number of Insects in New Jersey, as recorded in Smith's List. The classification differs somewhat from the one used here.

most of the insects which attract his attention and to find the answer to most of the questions he is tempted to ask the specialist. It is not intended to be a manual of economic entomology although most of our relatively few injurious insects are included. It is intended to be an introductory field book to commonly observed species and the larger groups of insects. Although the species mentioned are, for the most part, inhabitants of northeastern United States, many of them have a wide distribution in this country and some of them even in other continents. I hope, therefore, and especially since the generalities are more important than concrete illustrations, that this little book may be useful to laymen "wherever dispersed." You can provide your own concrete illustrations, once you have the general idea. I have been governed in the choice of subject matter, not so much by what I think ought to be in a book on insects as by what the public seem to want to know, judging by the letters received and personal inquiries made at an institution whose motto is "For the people, for education, for science." Really the title might be *Answers to Common Questions about Insects.*

**Thanks**

We are, all of us, immensely indebted to those who have gone before us. The mass of knowledge about insects, great in reality but small in comparison with our ignorance, has been accumulated, bit by bit, by the laboring man in his Sunday strolls and by the highly trained investigator. Much of this has been told over and over; none of us can hope to prove all of the statements. I have drawn freely on books and papers, too numerous to mention, for facts which I did not previously know—some of which I have already forgotten. This book is frankly a compilation and will be useful in proportion to the skill with which the selections were made and put together. The new illustrations, about 700, have been made by Mrs. E. L. Beutenmüller, largely from specimens in the American Museum of Natural History; and those concerned with collecting methods and galls are copied from papers published by that institution, which has also kindly permitted me to use much of

its time in the work. I thank, also, the following friends and associates for helpful suggestions and criticisms: H. G. Barber, concerning Hemiptera; J. Bequaert, Diptera and Hymenoptera; Wm. T. Davis, Odonata and Orthoptera; E. P. Felt, galls; C. W. Leng and A. J. Mutchler, Coleoptera; F. E. Watson, Lepidoptera; and Herbert F. Schwarz, who kindly acted as a "lay critic."

**About Names**

At the afore-mentioned institution we were once severely criticized by an excitable visiting school-marm because we had labeled a number of exhibition specimens with their scientific names but had neglected to give English names to them. I had been trying, for some time, an interesting experiment on several children with whom I had been rather intimately associated (they were my own). The first move was to tell one of them that the name of a certain burly bee she saw in the garden was *Bombus*. About a week later there were near-tears because a neighbor insisted it was a Bumble-bee. Matters were smoothed over by explaining that *Bombus* was the real name for such bees and Bumble-bee was a nickname. There are thousands of kinds of native-born, United States insects which have been really-named but not nicknamed. I have made an effort in this book to record the real names correctly and have given the nicknames when I knew them; when I did not, I usually have left you the pleasure of inventing new ones. Often real names are no longer or harder than the "common" names. An insect is considered to be christened when some student, who has found a kind which he thinks has never been named, publishes a description of it and gives it a properly formed name. If somebody had previously named the same kind, the prior name usually holds. There is a complicated code governing the matter, and the changing of scientific names, which has so worried many readers, is caused by the discovery and rectification of violations of this code. The shaking-down process is painful but ultimate stability is hoped for and, withal, I feel sure that the "real" names are better than the best nicknames.

## TAXONOMY.

**The System**

Clearly some system of filing is necessary in order to keep track of the hundreds of thousands of insect names. A business man keeps his reference cards or letters in groups and sub-groups. As his business grows he not only adds new groups but he breaks up the old groups into finer divisions. It is the same way with the arrangement (taxonomy) of insects. Formerly nine major groups ("Orders") were enough for insects, the "Class" of animals with six legs. The latest works divide insects into several Classes and there are nearly forty Orders. Not to make it too complicated, we will follow a moderate course and consider all insects as belonging to one Class, which is divided into about two dozen Orders. Flies, in the strict sense, have no more than two wings and belong to the "two-winged" Order (Diptera); the Order to which butterflies and moths belong is Lepidoptera; that to which beetles belong is Coleoptera; and so on. Orders are divided into "sub-orders" and these into "families." Lady-bird beetles belong to the family Coccinelidæ, while carpet beetles are Dermestidæ. Family names always end in dæ and sub-family names in næ. The next division which need concern us is "genus"; and then "species." The names of these divisions are the ones ordinarily used. The generic name should always be written with a capital and the specific with a small initial letter; they are usually printed in italics. Bumble-bees are *Bombus;* a common species is *Bombus pennsylvanicus.* Some species have varieties; for example: one of our beautiful butterflies is *Papilio glaucus* variety *turnus.* This system is more than a pure matter of convenience; it aims to point out relationships. The species of a given genus are supposed to be more closely related to each other than they are to the species of other genera of the same family, and the different genera of a given family are believed to be more closely related to each other than to those of other families of the same order and so on.

The technical entomologist will notice that the arrangement of our text does not follow absolutely any one of the arrangements with which he is familiar. This liberty was taken because it was believed that certain deviations would

be more convenient for the layman,—a liberty somewhat to be pardoned by reason of the fact that few technical books agree among themselves. Brues and Melander's *Key to the Families of North American Insects* is the best, recent, detailed treatment of the subject.

**Concerning Measurements**

Much against my inclination, I have given measurements in inches. This has made it necessary to use various fractions and these are awkward things to get at on ordinary rules. In using measurements, it must be remembered that there is considerable variation in the size of the same species and, even where upper and lower limits are given, these limits may be overstepped by exceptional individuals or by many individuals in exceptional seasons or localities. In those illustrations which are not natural size, the average size of the insect is usually indicated by a line near the figure.

**Growth**

Thus early be it said that insects do not grow after they have attained wings. Small, winged flies do not grow to be large, winged flies even though the same kitchen window frequently contains all sizes. There are two main sorts of life histories, called respectively Incomplete and Complete Metamorphosis. Insects having the first kind, grasshoppers for example, look, when they leave the eggs, more or less like miniatures of the adults except that they have no wings even if the adults have. Insects of the second sort may be as different, when they hatch, from the adult as a caterpillar is from a butterfly, and they usually go through a resting (pupal) stage before they get wings. Young insects may be said to grow by leaps and bounds, not gradually. They are largely covered, like lobsters, by a shell which will not stretch. All the flesh is inside of this shell, and when the quantity of this flesh gets too large the shell splits, usually down the back; the insect emerges, swells out, and his new skin again hardens by reason of the chitin it contains. This process is repeated several times before adult life is reached. The number of molts is usually very definite for each species and sometimes an

insect, so starved that it has not largely increased its flesh, will, nevertheless, carry on its accustomed molts. In the case of winged insects having incomplete metamorphosis, the developing wings show as pads several stages before the adult. In those having complete metamorphosis, even the full-grown larvæ have no external indication of wings; these appear externally after the molt which results in the pupa and, when the pupa molts, out steps the winged adult.

**The Inside** Mention has been made of the hard ("chitinized") skins of insects: it is their skeleton and their muscles are attached to it. In man, the blood is sent to the lungs for a load of oxygen which it then carries to the tissues. Insects do things more directly; air is conducted to all parts of the body by means of a system of tubes called tracheæ. This system usually has a number of outside openings (spiracles) placed along each side of the body, but there is none on the head. Insects do not breathe through their mouths. Blood completely fills the body cavity and is kept in motion by means of a "heart" which is merely a pulsating tube open at both ends. The central nervous system is a double, longitudinal series of ganglia connected, one with another, by cords. There is no brain, strictly speaking, for the ganglia in the thorax seem to be about as important as those in the head. Nerves run from each ganglion to nearby parts of the body. Most insects seem to smell by means of their antennæ and some to hear with the same organs, but the location of "ears," if "ears" exist, is various and not always known.

**The Outside** All insects are divided into three parts: head, thorax and abdomen. In some larvæ these parts are not distinctly marked off, but usually there will be no difficulty in recognizing the head. The thorax bears the wings, if any, and the true legs, if any. No insect ever has more than three pairs of true legs, and no other creatures which the amateur is likely to notice and confuse with insects have as few as three pairs of legs. The part of the thorax which bears

the front legs is called the prothorax; the middle legs are on the mesothorax; and the hind legs, on the metathorax. The top is called the notum and the under side the sternum. We have, then, "pronotum," "prosternum," and so on. The abdomen is the part of the body back of the thorax. In many larvæ, such as ordinary caterpillars, the abdomen may have leg-like, fleshy props or claspers, and in many adult insects there are "caudal" appendages of one sort or another at the hind end of the abdomen. Going from the thorax outwards, the principal parts of the legs are coxa, trochanter, femur, tibia and tarsus. The tarsus is usually made up of several joints and usually ends in one or more claws. The first joint of the tarsus is sometimes much larger than its companions and is called metatarsus or basitarsus. The big joints of the leg are the tibia and femur. The trochanter is small and sometimes two-jointed. The coxa usually looks like a small part of the thorax. An insect's jaws chew, if they do chew, sideways, not up and down. The mouth parts are subject to a great deal of modification and in some groups, instead of biting, they pierce and suck. Typically, there are two sets of jaws: mandibles and maxillæ. The latter are usually the more delicate and are furnished with a pair of feeler-like structures called palps. The lower lip (labium) also has a pair of palps. These two sets of palps are supposed to be tasting organs. The eyes are of two sorts: compound and simple. The pair usually noticed are the compound eyes and are compact clusters of single eyes (ommatidia). Some insects, such as certain "silver-fish," have not more than 12 ommatidia to each eye; and some hawk-moths, 27,000. The simple eyes (ocelli) are situated between, and usually a little higher than, the compound eyes. There are usually three. Finally, the outside of an insect's body is usually more or less covered with hairs. In butterflies and moths these hairs are largely scale-like. When descriptions refer to hairy eyes, do not expect too much; a lens is usually necessary to see these hairs. This is about all the anatomy one needs to start with. More will be explained as occasion arises.

## COLLECTING AND PRESERVING INSECTS

The following directions are, with slight changes, those which are contained in the American Museum's leaflet on *How to Collect and Preserve Insects.*

### When and Where to Find Insects

An entomologist is frequently amused at being asked by well-meaning friends if he found anything when he went out. Insect hunting is a sport in which there are no blanks, if you know the game. Frequently the most unpromising times and places are the best, for others have been discouraged by the outlook and you get what they have missed. We can never truly say that we know an insect's haunts until we can tell where to look for it every hour of every day in the year. Many insects are great hiders and should be looked for under bark; in rotten wood; under stones, dead leaves, etc.; among the roots of plants; in stems and flowers—in short everywhere and at all times.

### Collecting Apparatus and How to Use It

The great essentials for insect collecting were given each of us at birth and need only be improved by use—an inquiring mind, eyes and fingers. Only a very few insects sting to such an extent that collecting with unaided fingers is uncomfortable and even the swiftest fliers can be caught by hand when they are young or asleep. However, certain tools are handy. They can either be made at home or purchased rather cheaply from dealers.[1]

[1] The principal dealers in this vicinity are Kny-Scheerer Co., 404 West 27th St., New York City; Ward's Natural Science Establishment, Rochester, N. Y.; New Jersey Entomological Co., 74 Thirteenth Ave., Newark, N. J.; O. Fulda, 812 Broadway, New York City; and Williams, Brown & Earle, 918 Chestnut St., Philadelphia.

Mention of insect collecting immediately suggests a net. For the capture of adult butterflies, moths and other delicate, flying creatures this should be of the lightest possible material. Fine Brussels net or bobinet is used for the larger sizes (1 to 2 ft. in diameter) and silk veiling for the pocket sizes. The depth of this net should be at least twice the diameter of its rim so that, when an insect is caught, a twist will fold the bag against the rim and leave the insect imprisoned in the lower end of the bag. The beginner is apt to choose too long a handle and can then take only long slow strokes even if he avoids getting all mixed up with the vegetation and interfering with his fellow collectors. Three feet is long enough for a handle.

The sweeping net should be made of stout, white muslin, or light duck, on a strong rim well fastened to a handle of such a length that the user can just touch the ground with the rim of the net without stooping. The diameter of the net depends somewhat on the strength of the user and its depth may be from 1½ to 2 times its diameter. It is used to sweep blindly through grass, bunches of flowers, light bushes, etc., in a fairly certain expectation of getting something. Much of the material will be damaged by the rough handling, but it is the quickest way to get large numbers of specimens, and the only way to get certain things quickly. The tendency seems to be to make the handle of the sweep net too short, some on the market being only 6 in. long. These do not tire the arm so much as nets with longer handles, but you either miss the insects living near the ground or you get a very tired back. One useful trick in sweeping is to have a small cushion of cotton, covered with cheese-cloth or muslin, and a bottle of chloroform or ether. After sweeping for a few minutes moisten the cushion with the anesthetic, drop it into the net, and quickly twist up the bag so that the fumes are confined. In a short time even the liveliest grasshopper will be asleep and can be picked out and either saved or rejected. If rejected, they will all shortly revive and walk, hop, or fly away. The cushion is not strictly necessary as the chloroform may be put directly on the net after the insects are folded in the bottom.

The third net of the complete outfit is the water net. The bag should be of some strong material through which water will run readily. The rim should be strong and may be either circular in outline or flattened at the side opposite the handle. The advantage of the flattening is that the bottom of ponds can be skimmed, but the circular rim does fairly well, as the stirring of the water stirs up even the insects at the bottom and they are caught in the return swish of the net. A great deal of mud and weeds will also be caught, but devices to prevent this, such as covering the mouth of the net with a coarse wire screen, do not work well in collecting insects. After clearing the net of mud as much as possible by washing it through the net, dump the rest on the bank, preferably in the sun. Some insects will probably be seen at once, others will appear as the mass dries out. After you think you have found everything, wait a while and look out for very small beetles. Many collectors miss them.

Many, or most, of the nets that are for sale have folding rims and jointed handles. Opinion differs as to the best. When, as is often the case, lightness and ease of transportation is an object, it is well to have but one handle and frame, with interchangeable bags. The landing net used by fishermen, in which the frame consists of two pieces of flexible steel that lie close together when not in use, is excellent. The two-jointed handle is better than the three-jointed one, as one of the joints of the former is just right except for high flying or deep diving quarry. In these cases add the second.

A sieve is handy for getting the small insects hiding under accumulations of dead leaves, in moss, trash, etc. Two sieves with meshes of different size are handier. A good plan is to have a strong bag about a foot and a half square by two feet deep. About nine inches from the top sew pieces across the corners so that a piece of half-inch mesh wire screen can rest on them. Sift through this until there is quite a bit of fine material in the bottom of the bag and then retire to a comfortable place protected from the wind and spread a small sheet of white muslin or

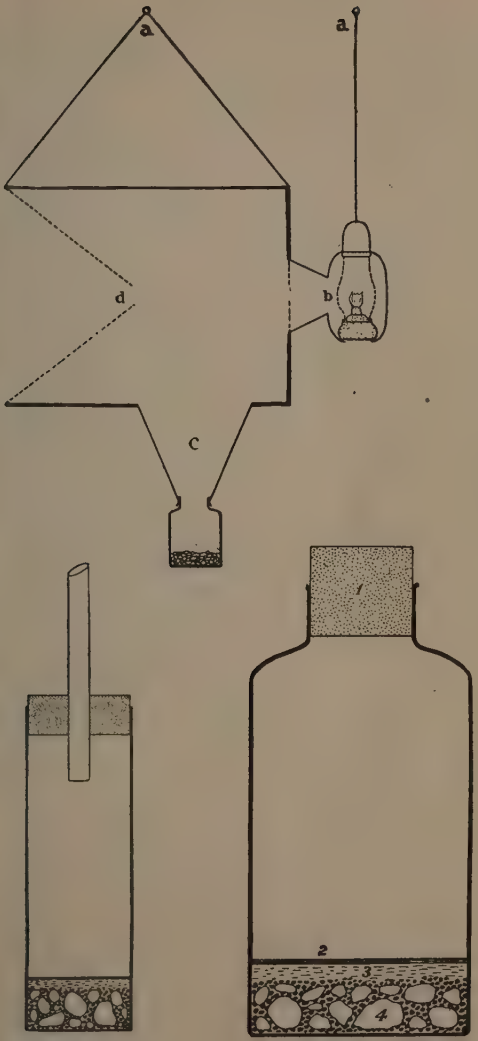
canvas. Now resift, using a mesh about four or five to an inch. The flat-bottomed sieves, six or eight inches in diameter, which are used for making French fried potatoes, and the new wire pie-pans are excellent. Sift a very thin layer on to the white cloth and examine carefully the coarse stuff for relatively large things before it is thrown away. Be patient with the small stuff. Insects have a habit of "playing possum" and have plenty of patience themselves. They do not seem to like tobacco smoke. If you do, blow some on the litter. It will hasten matters,—at least, smokers think so.

This is a good place to mention collecting forceps, as they are almost necessary in picking up very small insects as well as insects concerning whose ability and inclination to sting there may be some suspicion. The best forceps for handling very delicate insects do not seem to be on the market. They are made of strips of German silver and have small but rounded points. However, small steel ones do very well. Steel forceps about a foot long are handy for picking caddice cases, etc., out of water, but they are of little use in general work. Dealers also carry forceps having gauze-covered frames at the tips. They are meant for holding stinging insects while they are being examined, but they, also, are of very little use to the general collector.

A strong knife for cutting off galls, stripping bark, splitting infested branches, etc., is essential. A trowel is useful in following insect burrows or digging for root borers. The entrenching tool used in the army is a handy, all-around substitute for trowel, hatchet, and large knife.

There are two chief methods of night-collecting in general use: "sugaring" and at light. Another, while not so productive of specimens, is more interesting. It consists in simply prowling around with lamp, examining the center of flowers, the underside of leaves, tree-trunks, etc., to find out what the nocturnal insects are doing and also where and how the day-flying insects are passing the night.

PLATE III



There are about as many recipes for making the sugar mixture as there are for "mother's biscuits." Baking molasses usually forms the basis. Some additions are any combination, or all, of stale beer, rum, asafœtida and brown sugar. The mixture should spread easily but not run badly. It is to be applied before dusk on tree trunks, fence rails, and the like. Starting from some comfortable resting place as a base, lay out a circuitous route, "sugaring" something every few feet, and end at the resting place. After dark, if luck be good, the sugared strips will be full of moths and other insects eagerly sipping the sweets. Several wide-mouthed cyanide killing bottles (see p. 16) will be useful, but a net will be practically useless. It is well to have a little ether in each bottle, and do not put a moth in a bottle until its predecessors have stopped fluttering. Only experience will teach how to catch these moths with a bottle. Some fly upward when disturbed and some fly straight out or sideways, but the majority drop a few inches before flying; so, when in doubt, hold the bottle slightly below the prospective captive.

Light attracts many sorts of insects besides moths. Street and porch lights are fruitful hunting grounds. A lamp by an open window makes the room it is in a splendid trap or a smaller one can be fixed up and put "in the field." Plate III. shows the principle. The details vary to suit collectors' whims. It is not difficult to make the box collapsible so that it can easily be transported. An ordinary barn-lantern set in the center of a white sheet or a "bull's eye" throwing a light against a sheet hung over a fence or between trees does very well. In the latter cases a net will be desirable but not easy to use. Last summer I used, with great success, a cheese-cloth tent with a muslin ground-cloth. The tent was A-shaped, about 9 x 6 ft. on the ground and 6 ft. high, with inward-pointing flies at each end. A lantern (or two) was placed inside. The outside worked like a sheet and the inside was a trap. Both light and sugar work best where there is a variety of vegetation, as where woodland passes into swamp or where there is an abundance of second growth.

Many other sorts of traps have been devised. Olive bottles and fruit jars buried up to the neck in the ground and baited with molasses, meat, etc., are simple and effective. The insects caught in this way may be washed off and will be nearly as good as new. Boards, daubed on the under side with molasses or covering meat, are not bad. Girdled branches and cut limbs, hung up, attract wood-boring insects which can then be collected by beating them into an upturned umbrella by sharply rapping the limbs with a stout stick. In fact, an umbrella is a very useful piece of apparatus. Branches, both living and dead, are full of insects. The inverted umbrella catches what are knocked off but does not hold them for long. The collector must act quickly. Some collectors put a quill in the cork of a collecting tube as shown in Plate III. If the outer end of the quill be put over the insect, it will crawl up through the quill and into the bottle from which exit is difficult. If the umbrella be white, or at least lined with white, the insects can be more easily seen but so can the collector—not by the insects particularly, but by inquisitive humans—and the non-committal black does very well.

Beating will knock down many larvæ. Directions for preserving them are given on p. 22. Some, at least, should be reared and here ingenuity is of more value than volumes of instructions. The beginner will doubtless be inclined to give his charges more light and air than is necessary. Pasteboard shoe-boxes are excellent for large caterpillars. Tin boxes keep the food longer and are easily cleaned, but must be watched carefully or the food will mould. If the food-plant can be potted, a good contrivance is to slip a lantern globe over it, sinking the bottom far enough in the ground to prevent the escape of larvæ in that direction and covering the top with cheese-cloth. Even if the plant cannot be grown, twigs can be kept fresh for some time by keeping their cut ends in a small bottle of water sunk in the ground and used inside a lantern globe. (See Plate IV.) The twigs will be held in place and larvæ prevented from drowning if cotton be loosely stuffed in the neck of the bottle around the twigs. It is well to throw a thin layer of dirt over the cotton so that fallen larvæ can easily

get back to their food. Another device is shown, in section, in Plate IV. It is made of plaster of paris. The water at *b* keeps the block moist. It is useful chiefly for ground-inhabiting larvæ or for galls. However, for the latter, fruit jars with moist sand or a moist sponge in the bottom do just as well or better. Do not forget the larvæ living in hollow stems, dead wood and under bark.

When caterpillars are about to molt, especially when they are about to change to pupæ, they stop eating and act as though they are sick. If you are in doubt as to how the species pupates, it is well to give it potting soil covered with dead leaves and some twigs of their food-plant, not merely fresh leaves. A desirable, but not necessary, refinement of technique is to bake the soil in order to kill bacteria and fungi. Species which "should" pupate underground will get along fairly well even if they have no earth—much better than if they be covered with earth after pupation takes place, as this would pack them and that is injurious.

## Killing

Up to this point but little mention has been made of killing insects and that was really not necessary. Insects can be studied alive with great pleasure and profit. However, there are so many kinds and the differences between species are often so minute that it is well to kill and preserve at least samples. Fortunately, this can be done with less trouble and less injury to the balance of Nature than is the case with most animals or even plants. Furthermore, the collection can be made very attractive and instructive without taking up much space.

The best all-around killing agent for adult insects is cyanide of potassium. It should be broken into pieces varying in size from that of a small pea to that of a hickory nut, according to the size of the bottle to be used. Olive bottles make good medium-sized bottles, while fruit jars are better for large-sized moths and butterflies. Tubes, even as small as ¼ in. in diameter by about 2 in. long, are not too small for some things. Avoid bottles with strongly constricted necks. Avoid, also, bottles made of

thin glass. There are many ways of keeping the cyanide in position and the bottle in good condition. The most general way is to pour a thin layer of plaster of paris over a layer (from ¼ to ⅓ in. deep) of cyanide. However, since such a bottle will quickly get too moist from the specimens and the decomposition of the cyanide, some further device is almost always used. The pieces of cyanide may be wrapped in soft absorbent paper or imbedded in dry sawdust before the plaster is poured on. Another way is to imbed it in dry plaster before pouring on the wet. A piece of blotting paper should be fitted tightly over the plaster after it has "set." See Plate III. Some do not use plaster but imbed the cyanide in cotton and cover this with a piece of blotting paper or a thin porous cork. A dangerous, but otherwise fairly satisfactory, method is to imbed a piece of cyanide on the inside surface of the cork and have none in the bottle itself. This bottle will be dry but not strong, and as the cork will, in time, become saturated with poison it will be very dangerous. It is always well to have a few narrow strips of loose absorbent paper in the bottle. They prevent injury to the insects by shaking and help keep the bottle dry, as they can be frequently changed. As ordinarily made, a bottle should be allowed to ripen for several days before using. If wanted at once, put a few drops of vinegar or a pinch of boracic acid powder with the cyanide. Collectors of delicate moths and butterflies frequently put a few drops of ether or chloroform in their cyanide bottles before starting out. This is to quiet the insects at once for the cyanide sometimes kills slowly. Experience will teach the collector that some insects die very slowly and revive after apparent death. On the other hand, ether and chloroform make insects brittle and too long an exposure to cyanide fumes changes the color of some insects.

Practically all beetles and dragon flies, together with dull-colored, hairless insects of other orders, can be killed in alcohol and kept there indefinitely. Fifty % is strong enough for killing and 70% for preserving. Higher grades make them brittle. No fly, bee, butterfly, moth, or any green insect, other than those previously mentioned,

should be put into alcohol. In an emergency, kerosene, gasoline, or benzine, put on the thorax, will kill and give satisfactory specimens. Pounded laurel leaves and peach pits make a weak killing agent, and butterflies and moths may be killed by carefully but firmly pinching the thorax between the thumb and finger, one on each side. In fact, many collectors of these insects pinch their captures before taking them out of the net. This prevents their injuring themselves by thrashing about.

### Mounting

The stock method is pinning. The almost universally adopted pin is 1½ in. long, and has a very small head. It varies in thickness from extremely slender to as thick as an ordinary pin. The useful sizes are from No. 0 to No. 3. They are either plain "white" or enameled black. Much is to be said for both, with the voting probably in favor of black. At any rate, they should snap back when bent a reasonable amount. A pin that bends easily and stays bent produces profanity. Beetles are usually pinned through the right wing-cover. All other insects, when pinned, are pinned through the thorax. In the case of flies it is well to pin a trifle to the right of the middle line, as the bristles on the back are important in taxonomy and one side of the body should be perfect. True bugs should be pinned through the triangular portion of the thorax which is between the wings.

Very small insects are usually mounted on the tip of paper triangles, a medium-sized pin being stuck through the broad end of the triangle. The triangles are of about as many sizes as there are collectors. A ticket-punch can be purchased which has a die suitable for cutting these triangles. However, if they be cut out with scissors or a sharp knife a variety of sizes and shapes suited to different insects can easily be made. The best way is to cut tough, rather stiff paper into strips about .4 inch wide and then snip off triangles from them by making transverse cuts. It is well to pin up a quantity of these triangles in odd moments and keep them on hand. When ready to mount, put a small bit of white shellac dissolved in alcohol,

or of some good elastic glue, on the tip of a triangle and touch it to the underside of the thorax. Some difficulty will be experienced in keeping the insect straight on the point, especially if the adhesive be too thin. The triangles for ants should be fairly broad at the "point," and the front end of the abdomen as well as the thorax should be supported.

The method just mentioned is almost universally used for small beetles. Small flies and the like are frequently mounted on "minuten nadeln." These are short, very delicate, headless pins. Bits of pith, cork, or firm blotting paper (used edgewise), serve to connect nadel and a regular pin. The nadel may be stuck through the insect and then into the support. A somewhat better plan is to arrange a number in advance by sticking the nadel through the support from below, leaving the point stick up; then mounting can be rapidly done by piercing the insects from below. It is well, in this case, to stop before the point comes entirely through the back as then no pin shows and furthermore the characters on the back are not marred. "Minuten nadeln" have the advantage over glue on triangles that the glue does not always hold. On the other hand, they cannot be used with many hard-shelled beetles. Elbow pins are sometimes used but are, as a rule, not very satisfactory. All mounts mentioned in this paragraph are usually put on the left side of the pin.

The height of the insects on the pin is important for the final appearance of the collection. A strip of cardboard whose width is ¼ to ⅓ the length of the pin makes a convenient gauge. With one edge held at the head of the pin push the insect up until it touches the other edge. Or a block of wood containing a hole whose depth is ¼ to ⅓ the length of the pin may be used. Devices for regulating the height by sticking the *point* of the pin into a gauge are not satisfactory because of the varying thickness of the specimens.

Mounting insects in balsam on glass slides will probably not be taken up by the general collector unless he be already accustomed to making balsam mounts. It is, however, the only satisfactory method of getting extremely small forms ready for study.

In collections, butterflies and moths usually have all four wings expanded to their utmost and more or less in line with the lateral axis of the creature's body. This makes a nice-looking collection and is the best that can be done with most butterflies. However, many moths have natural rest positions which are not only interesting but save space. It is well, therefore, to expand the wings of the left side so that the markings on both front and hind wings show, but to leave the right wings in the natural rest position. The reason for expanding the left side, rather than the right, and for putting the triangles, etc., on the left side is that most people are right-handed. This arrangement makes it easy to use the pinning forceps with the right hand. For the same reason, when the wings on one side of grasshoppers, wasps, etc., are to be spread, the left wings should be selected for the purpose. Pinning forceps are strong forceps with broad, roughened ends and are useful for pushing the pins into the cork of the storage boxes.

The most common form of spreading board is illustrated in Plate IV. The sides are made of soft wood. In the bottom of the central channel is a piece of soft cork. After pinning the insect, push the pin into this central cork until the back of the insect is nearly flush with the board. Then draw the wings to the desired position by means of forceps or of a fine needle caught in the strong front margin of the wings. Never use the fingers on moths and butterflies, as this will rub off the scales which cover the wings and give color to them. The wings may be kept in position by means of fine pins, or bits of heavy glass, or strips of tracing cloth held in place by pins placed outside of the wings. A combination of the last two methods, glass on paper, is best. It is well to have a number of boards with grooves of different widths for use with different-sized insects. The same plate shows a setting board devised by Mr. Chas. E. Sleight—and perhaps by others—for spreading caddice flies and other insects when it is desired to have the legs spread as well. The holes running down the center are just large enough to accommodate that part of the pin which is above the insect. The wings are spread as before, except that now the under side is visible to the worker and the legs are accessible.

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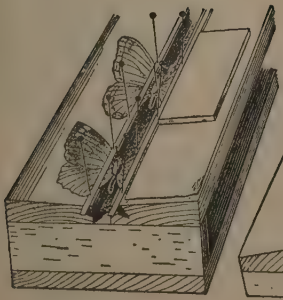

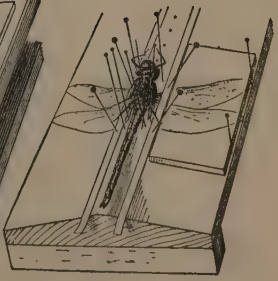

Should insects get dry and stiff before they are spread, they must be relaxed. This is done by putting them in a covered jar or tin box containing water or moist blotting paper. A few drops of carbolic acid added to the water will prevent mold. Twenty-four hours will usually be sufficient to relax even the driest, but more time may sometimes be necessary. If the insect has neither scales nor hairs, it can be quickly relaxed by immersing it in warm water.

It will be noticed that both of the setting boards illustrated here give the wings a slight upward tilt. If they keep this position, it will not be objectionable, but they are not likely to do so, since the weight of the wings will probably drop them at least to the horizontal. Large insects dry more slowly than small ones and it will probably be necessary to allow them to remain on the boards for about two weeks. They should certainly remain until thoroughly dried. No further preservation is then necessary, as a rule, for the fairly hard-bodied, adult insects. Some tropical grasshoppers have large abdomens full of fat and decomposing food. These should first be opened by an incision along the belly, the viscera taken out, and the abdomen stuffed with cotton.

Broken insects may be repaired by the use of shellac or thin glue.

Caterpillars may be prepared in the following way: Make a circular incision at the hind end, cutting the intestine loose from the outer body wall. Then, laying the caterpillar on a piece of clean blotting paper, squeeze the viscera through this opening by gently rolling the caterpillar with a lead pencil, beginning near the hind end and gradually working toward the front. After the viscera have been gotten rid of, for the most part, insert a straw and fasten the first segment of the larva to the end of the straw by means of a fine needle. Draw the hind segment up the straw until the larva is natural length and fasten it in the same manner. Then, inflate the larva by gently blowing through the straw. Since the front end of the straw may get plugged up, it is well to make a small hole in the side of the straw before it is inserted. This hole had best come about midway between the larva's head and

tail. Since inflation must be kept up until the larva's skin is dried, gentle heat is usually used. A tin can, with holes punched in it for ventilation and heated by an alcohol lamp, makes a good oven, or one can be purchased. Dealers also sell bellows, tubing, clips, etc., to make the work of inflating easier. However inflated, green larvæ are apt to lose their color, for it is chlorophyll which fades rapidly. Slow-drying paints relax the skin and distort it. Therefore, if painting is done, the pigments should be mixed with benzine or the like.

## Field Notes and Labels

It is only by the greatest chance that the beginner gets a new or even rare species on ground that has been worked over by experienced collectors, but even the primary class in entomology may add to our store of knowledge if it keeps field notes well. Date of capture and locality are considered of prime importance. They should always be known and kept with every specimen, but the distribution and time of appearance of our more common species are known. It is of their habits that we are ignorant. What do they feed on? Under what conditions are they to be found when young and when old, day and night, winter and summer? What do they do and how do they do it? Some system of keeping notes is imperative if your collection is to be worth while.

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Tukeit, BG. 1911
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The pin label should be small but legible. Certain firms make a business of printing these labels from small type, or the collector can make up a sheet by means of an ordinary typewriter (black ink is best) and have a block made from this, greatly reduced in size. From this block any number of impressions can be made. Any printer will attend to the whole business. Sample strips are shown in the margin. If dates are not printed, they should be filled in before cutting the labels apart. Field numbers can be written on the back of these labels or put on a separate label. The collector's name can also

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be put on a separate label. Similar labels should all be the same height on the pin throughout the collection. This is easily accomplished by sticking the pin first through the label then into a hole of a given depth or cork of a given thickness, thus pushing the labels up to a uniform height.

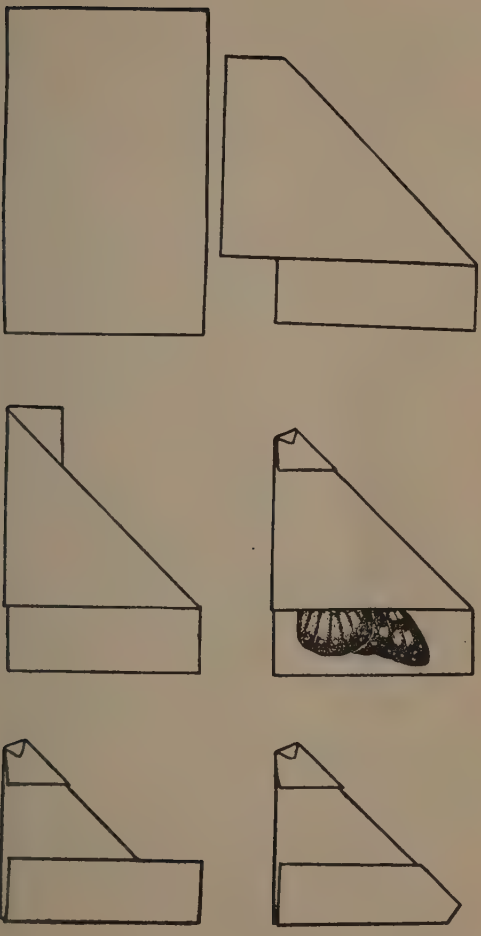
### Storage Boxes and Care of Collection

Since certain members of a family of beetles (Dermestidæ) are given to eating dried insects, the storage boxes should have tight-fitting lids. Except for that, almost anything will do. Cigar boxes are not bad if carefully watched, but better boxes can be purchased at reasonable prices from dealers. Glass-topped drawers are nice but not necessary. Whatever sort of box is used, the bottom, inside, should be covered with something which is soft enough to allow a pin to enter easily but which will hold the pin when it is once in. The compressed cork of the dealers is best. Sliced cornstalk is used by some beginners but two layers of the corrugated paper, such as bottles are packed in, is better than cornpith. The layers should be placed so that the corrugations run at right angles to each other.

In spite of precaution, Dermestids may get in; although camphor balls or flaked naphthalene will help to keep them out. If camphor balls are used, first heat the head of an ordinary pin and, while hot, push the head into the ball. When cool, it will be solid and the ball can be pinned into the box. If Dermestids do get in, they may be killed by pouring into the box about a teaspoonful of carbon bisulphide and closing the lid down tightly. Remember that the bisulphide is very inflammable.

### Packing Insects in the Field

It frequently happens that the collector cannot attend to his catch at once, or possibly for months. Of course those things which are collected in alcohol may remain there. Butterflies and the like should be put into triangular envelopes. The manner of making these is shown



in Plate V. Never put more than one specimen in an envelope. Other insects can be packed between layers of cotton and cheese-cloth, with naphthalene flakes put in to keep out ants, etc., or they can be put in sawdust. In the latter case it is well to sprinkle carbolic acid on the sawdust to prevent mold. An excellent method of packing insects (except butterflies and moths) which are to be dried, is to make tubes of unglazed paper around a lead pencil, after writing the data on that part of the paper which comes outside. One end is closed by folding in the paper there, and then the tube is nearly filled with freshly killed insects. Finally, the other end is closed by folding in the paper. These tubes and the triangular envelopes can be packed in a cigar box and, if sprinkled with naphthalene to keep out ants and Dermestids, will keep indefinitely. Never pack moist insects in a tin box and never close even a wooden box tightly if there are many moist insects in it. Mold will result if you do.

### Identification

For this work a magnifying glass of some sort is usually necessary except for the larger Lepidoptera, and even with these it is useful when mouth-parts, and the like, are to be examined. If you collect at all extensively, you will get many species which are not mentioned here, at least in sufficient detail to enable you to fix on their names. Separate these into their orders and, if possible, families and even genera. Then await your chance to consult more technical books, or identified collections. Possibly you can arrange to have some specialist identify them for you, but this deprives you of the pleasure and benefit of doing it yourself. Furthermore, specialists usually have more than they can do, although they frequently are willing to look over collections which are not too miscellaneous for the privilege of retaining duplicates of the species they identify. If the species is undescribed, they usually wish to describe it and keep a set, one specimen of which is designated a "type" of that species. A very large majority of entomologists are kind, helpful individuals; I merely wish to say that laymen are often unwittingly unreasonable in their requests.

## ABOUT KEYS.

**Keys**

Such keys as are given here are, for the most part, simplified versions of keys in special, more technical, books and papers. They have been simplified in two ways: by leaving out forms which are not very likely to attract the notice of beginners or whose separation involves too great technicalities, and by using, as far as possible, easily appreciated characters even though they may not be, otherwise, the best characters to use. The result of the first simplification is that forms will be found which do not fit anything in the key although they may come close to it. An attempt has been made to word the keys so that forms which were not intended to be included will not fit anywhere, thus avoiding a misidentification. This attempt has not always been completely successful, especially for southern and west-of-the-Mississippi forms. Working a key backward, from the name to the start, usually gives so good a description of the form in question that it is not further described in the text.

**How to Use a Key**

Start at 1 and decide which of the two (or more) alternatives best agrees with the specimen; then go to the number indicated at the right; continue this process until a name without a following number is reached. *Do not take too much for granted.* If a thing is said in one alternative to be black, it is not necessarily not black in the other unless this is definitely stated. If you reach a point where neither alternative fits, go back to the place where you had most doubt concerning a choice and take the other alternative; perhaps the statements were not sufficiently clear and you made a wrong choice. If nothing works, it would be kind of you to conclude that you have a species which was not included in the key, although the fact of the matter is that it is next to impossible to draw up a relatively simple key which will not sometimes stick in the lock.

## THE CONTROL OF INJURIOUS INSECTS

This section may seem out of place in a Field Book, but the garden is a part of the "field" as far as insects are

concerned. I once made an at-first-sight rash statement to the effect that, every year, at least five hundred species of insects are naturally in my back yard near New York City. Some day I hope to prove it. Some of these insects are not welcome. Although the American Museum has no department of economic entomology, many of the inquiries, which are made there about insects, concern methods of control. I suppose, therefore, that "you," also, may have unwelcome insect visitors and would like some hints concerning their control.

If the injury is serious, write to your State Entomologist or to the Bureau of Entomology of the U. S. Department of Agriculture. They, especially the State Entomologist, should know about serious outbreaks; they are fitted by training and constant work along these lines to give good advice and, if the occasion demands it, personal supervision. Furthermore, you have a right to do this; you help to pay the salaries.

Few insects are injurious in all the stages of their life-history, and every one will admit that the fight against injurious insects should start before the injury begins. Mosquitoes and flies should be killed before they can fly; the first meal of leaf-feeders should be their last, even if they get that. All this requires a knowledge of the life-histories so that we may know the best time to fight. Fall or winter plowing may uncover pupæ which are hibernating in the ground, and kill them. If the insect passes the winter in the egg stage, spraying, provided spraying will kill the larvæ, should be done just as the eggs hatch. Therefore, we should know when that will be. This your State Entomologist can tell you for your particular locality and I can not.

Predaceous and parasitic insects are now "the one best bet" in economic entomology. Why cover our vegetation with poison year after year if we can set insect friends to killing insect enemies? This, again, is work for the professional economic entomologist, although I have tried to help you to distinguish friends from enemies.

If possible, prevent breeding. This applies especially to such enemies as mosquitoes and flies. Why live in a wire-and-wood cage when draining swamps, putting fish in ponds,

and similar preventive measures will control mosquitoes, and general cleaning up will do away with flies? Many insect enemies of cultivated plants breed on weeds. Either treat the "weeds" as cultivated plants or get rid of them.

Insecticides may be roughly divided into four classes: stomach poisons, contact insecticides, repellants and gases.

Stomach poisons are for such insects as chew vegetation. Nearly all of them contain arsenic in some combination and, if there be too much water-soluble arsenic, will burn the foliage. Now that insecticides are under government supervision, it is fairly safe to buy any standard brand and use it according to the directions on the package—these notes are for home-gardeners who would buy insecticides in small quantities and such quantities should not be purchased "loose." These directions will almost certainly call for lime, in order to neutralize the traces of soluble arsenic, and possibly resin-soap to make the poison stick to the leaves better. In spraying, cover every part of every leaf, if possible. For house-plants, an ordinary medicine atomizer is excellent. For garden plants, get a spray fitted to the number and size of the plants to be sprayed. Poisoned Bran Mash for grasshoppers, cutworms and the like, is made by mixing 1 part, by weight, of Paris-green or London-purple with 25 parts of bran and enough cheap molasses, diluted to about half-strength with water, to make a stiff paste.

Paris-green, etc., will poison humans if enough be eaten, but it is estimated, for example, that one must eat twenty-eight cabbages (that have been sprayed or dusted in the ordinary way) in order to swallow enough poison to be harmful. Hellebore is sometimes used because it is less poisonous to man and to other animals with less than six legs, but it is expensive and deteriorates with age. It may be used dry, diluted with about 8 parts of flour, or as a spray, one ounce to a gallon of water. If poisons are applied dry, the application should be made on a still morning before the dew has dried.

Contact insecticides are used against sap-sucking insects, which would stick their proboscis right through a layer of stomach poison and not be bothered by it. Chief among such insects are the aphids. Contact insecticides

are also effective against such leaf-chewing insects as have thin skins. A corrosive insecticide which is strong enough to kill an insect having a thick skin will kill the leaves also. Scale insects, except when young and scaleless, will resist any insecticide that leaves resist. Therefore, strong solutions (such as lime-sulphur) must be used on them before the buds break. Some contact insecticides work by clogging up the insects' breathing apparatus (tracheæ) rather than by corrosion. All contact insecticides should be applied, if possible, directly on the insect. It is usually a waste to spray them on leaves that are not affected.

Kerosene is very effective and may be applied pure about chicken houses and against bedbugs, but not on plants. For plants, an emulsion is used which can be purchased or may be made as follows: "Dissolve ½ pound of hard or whale-oil soap (or 1 quart soft soap) in 1 gallon of boiling water. Add 2 gallons of kerosene and churn with a force pump by pumping back and forth for five to ten minutes until the oil is thoroughly emulsified, forming a creamy mass with no drops of free oil visible. This stock solution is now diluted so that the resulting mixture will contain the desired per cent of kerosene. Thus for aphids one part of the stock solution should be diluted with from 10 to 15 parts of water, giving from 4 to 6 per cent of kerosene in the spray, while for a winter wash for San José scale, it should be diluted only three or four times giving from 16 to 22 per cent kerosene. The emulsion must be thoroughly churned and should be applied with a nozzle throwing a fine spray" (Sanderson).

Ordinary laundry soap, one-half pound to a gallon of water, is a good insecticide. Whale-oil soap is, perhaps, a little better. There are many brands of miscible oil which are very good. Lime-sulphur wash is used chiefly against the San José scale and is rather difficult to make at home. Pure sulphur dust is effective against "red spider."

Pyrethrum, or Persian insect powder, is much used about houses as it is not poisonous and does not injure fabrics, but it deteriorates with age. It works by suffocating the insect.

A tobacco tea made by boiling or steeping a pound of tobacco leaves and stems in one or two gallons of water is

used as a spray against aphids and other soft-bodied insects. House-plants may be dipped in this solution after it has cooled.

Among the repellants, tobacco dust, air-slacked lime, soot, and even fine road-dust may be mentioned but they are effective only so long as the plants are covered with them. "Fruit trees are often painted with a thick soap solution containing 1 pint of crude carbolic acid to 10 gallons as a repellant for the adult borers which lay their eggs on the bark." Tanglefoot is a sticky paste such as is used on fly-paper and, if a tree-trunk be encircled with it, crawling insects, such as caterpillars, will be kept from getting up. Do not be taken in by the charlatans who bore holes in trees and then plug them with something or other, on the theory that the sap will take up the poison and carry it to the leaves.

The principal insecticidal gases are carbon bisulphide, hydrocyanic acid, and the fumes of burning tobacco and sulphur. Carbon bisulphide is bad smelling, and will cause a headache if inhaled, and is very explosive but, if used with caution, is good for fumigating closets, entomological collections, and against boring and root-feeding pests, also to put in ants' nests. In buildings "there should be 1 square foot of evaporating surface to every 25 square feet of floor area, and each square foot of evaporating surface should receive from one-half to 1 pound of liquid." Hydrocyanic acid gas is so poisonous that I will not risk giving directions. If you want them, write to your State entomologist or to the U. S. Department of Agriculture. If sulphur be burned at the rate of two pounds per thousand cubic feet of space it is said to be effective against bedbugs and the like, but it will not kill the eggs, whereas kerosene will. Furthermore, it bleaches fabrics, if they be at all moist, and kills plants, if it be too strong. Tobacco fumes are safe *ad lib.*

Farmer's Bulletin, 127 of the U. S. Department of Agriculture tells a great deal about insecticides. This same Department will send you, free, a monthly bulletin which gives a list of their publications. Many of the publications have interesting accounts of insect life-histories and are worth having, even if the economic phase of the question does not appeal to you.

## CHIEFLY ABOUT SPIDERS

**Classes of Arthropoda**

Animals having no backbone but jointed legs are called Arthropoda. Some of these have two pairs of antennæ ("feelers") and at least five pairs of legs; these are Crustacea and include lobsters, crabs, crayfish, sow-bugs, and the like. Some have no apparent antennæ; one class of these live in the sea (the "king"- or "horseshoe crab") and another is, for the most part, terrestrial, breathing air. The latter class is called Arachnida and includes spiders and their relatives. Finally, there are three classes the members of which have one pair of antennæ. Two of them have more than three pairs of legs and no wings: the Diplopoda, or millipedes, have two pairs of legs on each of some, at least, of their body segments; the Chilopoda, or centipedes, have only one pair of legs to a single segment. The third class is Hexapoda, or insects; when adult, they never have more than three pairs of legs but usually have wings.

**Arachnida**

Some of the relatives of spiders have the abdomen distinctly segmented; if there is a tail-like hind end, it is a scorpion of some sort; if not, it is, in northeastern United States, either one of the small pseudo-scorpions or else a "harvestman," also called "grand-father-graybeard," "daddy-long-legs," etc.,—the creature some of us used to deprive of most of its legs in order that it should point the way to our cows or to our home. Mites and spiders have unsegmented abdomens; mites have no constriction of the body between the abdomen and the leg-bearing portion, but spiders do.

**Araneida**

Many of the not-yet-acquainted consider spiders to be insects and for that reason they are mentioned here—but briefly, because they have no more claim to be considered insects than have lobsters, except that they approach insects in the matter of interesting habits: home building, prey catching, mating, care of offspring, devices to escape their enemies, and the

like. Among other even more important differences, they have four pairs of legs; also the head and thorax are merged in one piece (cephalothorax). A pair of palpi are frequently so developed as to look like a fifth pair of legs. The eyes are simple, usually eight in number, and differing in size and arrangement in different sorts of spiders. The bite of all spiders is poisonous—that is the way they kill their food—but there is so little poison and so few spiders are strong enough to bite through the human skin, even if they would try, that spiders are not dangerous. At the hind end of the abdomen are small appendages, the spinnerets, from which come fluids that harden on exposure to air and form silk. The silk of insects comes from their mouths.

**Spiders' Silk and its Uses**

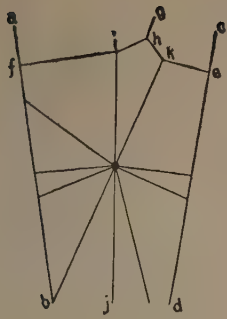
Its uses by spiders, I mean, although it has been used by man for cross-threads in telescopes and makes a better quality of textile than the silk of moths. One sufficient reason for man's not using it in the latter way is the difficulty of getting enough of it. Spiders originally used silk only to wrap up their masses of eggs (see *Lycosa*, Plate VII). Then they took to lining their retreats with silk; later they built platforms outside of their retreats and from these developed the snares which have been the wonder and admiration of all ages, humanly speaking. These snares, even those which are orb-shaped, differ greatly among themselves. Most of the orb-snares are made by members of a single family, Argiopidæ (or Epeiridæ), and a large proportion of our spiders make no snare, catching their prey by stealth, fleetness of foot or length of jump. Silk is used by certain young spiders for "ballooning"; they stand on some elevation, spin a thread into the air and, when the wind catches it, sail away. This is the explanation of "showers of gossamer."

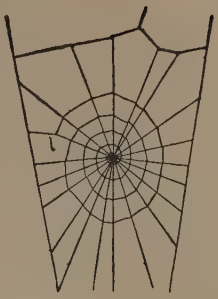
**The Kinds of Spiders**

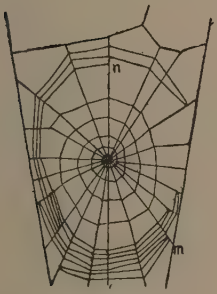
This is not the place to go minutely into the subject, but spiders may be divided into two sorts: what are called, in this country, tarantulas and the, strictly speaking, spiders.

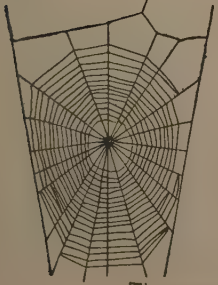
The large, hairy, much-feared tarantulas live in the South and some of them build interesting trap-door nests. The following families are true spiders. The DICTYNIDÆ belong to a group having special attachments on their spinning machine by which they make hackled bands in their webs; most of the tangled, sheet webs on the sides of houses, especially at windows, are made by *Dictyna sublata*. The THERIDIIDÆ have a well developed comb on the hind legs to aid in throwing liquid silk over the prey they wish to entangle; *Theridion tepidariorum* is *the* house spider, the one which makes the tangled web in the corners of rooms where "no beaux will go." *Latrodectus mactans*, a jet-black spider marked with red or yellow, living under stones or pieces of wood, also belongs to this family and is the only spider of northeastern United States concerning which there is even moderate evidence of its seriously biting human beings.

The ARGIOPIDÆ are the orb weavers, *par excellence.* They usually have relatively large abdomens. The maker and the making of a fairly typical web are shown in Plate VI, which is based upon an exhibit in the American Museum of Natural History. This spider is very common about buildings and has had a variety of names of which *Aranea sericata* is believed to be better usage than the more commonly employed *Epeira sclopetaria.* She started above *a* on a beam or twig and dropped, spinning a thread as she went, to another support below *b*, fastening the thread there. She then climbed this thread to the upper support, crossed over to a point above *c* and dropped to a point below *d*, making a strand as before. Then, going to *e*, she fastened one end of a strand and, spinning it behind her, went across by way of the upper support to *f*. She then went to the upper support and dropped to this *e-f* strand, fastening the new line at *h;* this pulled *e-f* up slightly. The next strand which she put in was from *i* to a point on the lower support below *j;* pulling this line made another angle in *e-f*, as did the following one from *k* to *b*. These last two strands were fastened near their center by a bit of silk and the remaining radii were put in by moving about on the foundation of the web. The next step in the operation was a laying



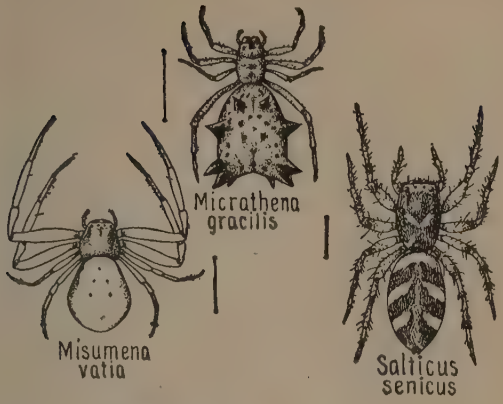





The Weaving of a Web

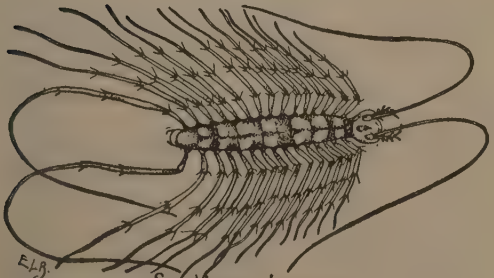
down of the primary spiral which is shown as ending at *l*. All of these threads consist of smooth, tough silk which is not sticky. From this point on the spider uses the sticky threads which constitute the real snare. All the details of spinning the web vary but the putting in of first sticky threads is very irregularly done. In the figure given here it may be followed from *m* to *n*. From *n* she continued in a regular spiral until the primary spiral of smooth silk was reached. She then cut away the outer portion of the primary spiral, so that she might have more room for the snare. This process of cutting away the primary spiral and putting in the sticky spiral is shown, in the fourth figure, about half finished; and finally there is the complete web with nearly all of the primary spiral removed. Nearly every species has its own distinct way of making webs and there are so many species of this family which are commonly noticed (especially the females when they are swollen with eggs) both because of their beautful colors and of their interesting webs, and some of the species are so variable, that not all of the probable questions can be answered. The spider an inch or more long, marked with spots and bands of bright orange and usually seen in the late summer hanging on an orb which is decorated with a zig-zag band of silk is *Miranda aurantia*, also called *Argiope riparia*. A slightly smaller, light yellow spider with narrow transverse black lines on its abdomen is *Metargiope trifasciata* and also puts a zig-zag in its web. Some species (*Micrathena gracilis* is shown in Plate VII) of this family have spine-like processes on their abdomens but *Aranea* is a fairly safe generic name to give to most of the orb-weavers generally noticed.

The THOMISIDÆ, or crab-spiders, have the two front pairs of legs relatively heavy and long; they run sideways. They spin no snare and the white or light yellow, sometimes with a light red band on the sides, *Misumena vatia* (see Plate VII) is frequently seen sitting in flowers, concealed by its resemblance to the flower and waiting to catch the insects which come for pollen. The flat, lustrous, parchment-like egg sacs often observed on stones in pastures belong to *Castianeira descripta*, one of the CLUBIONIDÆ. *Agelena nævia* is responsible for the flat



Lycosa and Egg-sac

Spirobolus marginatus




Scutigera forceps

horizontal webs which frequently almost completely carpet our lawns but are usually only noticed when covered with dew. It is one of the AGELENIDÆ. Another member of this family is *Tegenaria derhami*, a spider which lives with man from the Frigid zone to the Tropics, making a flat sheet, which is often dust-covered, in the corners of cellars, barns, and the like. The LYCOSIDÆ are, figuratively speaking as well as literally translating their name, Wolf-spiders. For the most part, they build no snare but secure their prey in the chase. Some species dig tunnels in the earth for hiding-places. A female is shown in Plate VII carrying her egg sac; after the young emerge they will ride on their mother's back, completely covering it, until, by the process of eating each other and any other food they can secure, they are able to shift for themselves. Finally we come to the ATTIDÆ, Jumping Spiders, of small size, numerous in species and replete with interest because of their beauty, their mating habits, their occasional mimicry of ants and other things concerning which you are referred, first of all, to Nature. If you see a small spider springing about, sometimes sideways or backwards, on a fence rail or the sunny side of a building, it is probably an Attid (possibly *Salticus senicus;* see Plate VII) and will repay further study.

**Diplopoda**

The large, commonly observed *Spirobolus* (Plate VII) is a typical Milliped. There are a number of smaller species in our gardens. These creatures feed on vegetable matter and are absolutely harmless. When disturbed, they curl up into a spiral and sometimes exude a defensive fluid.

**Chilopoda**

The bite of all Centipedes is poisonous and that of large species is dangerous. The only common sort in the North is *Scutigera forceps* (Plate VII). It lives in houses, feeding upon flies, cockroaches and other insects. Dr. Felt says "its presence in a house should be welcomed, since it is capable of inflicting no injury aside from a somewhat poisonous bite, the latter being extremely rare." I confess that any found in our house get stepped on.

## INSECTS

For certain distinctive characteristics of insects see p. 32 and the sections on anatomy in the Introduction.

### The Most Primitive Insects

These were, not long ago, all put in a single order: Aptera, or "wingless." They are now divided into four classes, including Thysanura and Collembola, and seven orders; but the user of this book is not apt to notice more than one or two species.

**Thysanura**

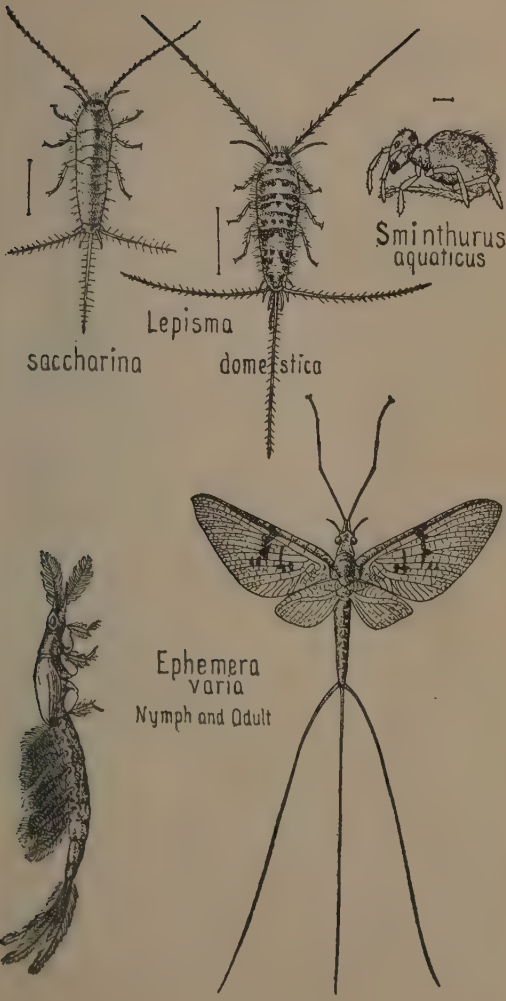
Two hundred and fifty-odd years ago Hooke wrote concerning the Silver-fish or Fish-moth: "It is a small Silver-shining Worm or Moth, which I found much conversant among Books and Papers, and is supposed to be that which corrodes and eats holes through leaves and covers; it appears to the naked eye a small glittering Pearl-colored Moth, which, upon the removal of Books and Papers in the Summer, is often observed very nimbly to scud, and pack away to some lurking cranney, where it may the better protect itself from any appearing dangers. Its head appears big and blunt and its body tapers from it towards the tail smaller and smaller, being shaped almost like a carrot." If such a creature is eating your wall paper, starched curtains or clothing, photographs or other belongings, your sorrow may be mitigated by your interest in seeing the most primitive insect you are likely to observe without special effort. Insects of this and related classes never have and never have had wings; they just grow up, from new-born to adult, with scarcely as much change as occurs in the growth of a dog. The species just mentioned is *Lepisma saccharina* (Plate VIII). It is a "moth" only because it eats furnishings and clothing. A related species (*domestica*) is abundant in some bake shops and old kitchens, running about even in hot places, whence its Old English name: Fire-brat.

**Collembola**

Frequently the surface of still pools is covered by a mass of tiny dark specks of insects which spring about, when disturbed, without even denting the surface film. Sometimes similar creatures are seen on the snow during bright spring days, becoming a nuisance in maple-sugar camps by getting into the sap. These are Collembola or Spring-tails—grotesque-looking creatures which, when at rest, keep the "tail" curved under them and jump by straightening out. See *Sminthurus aquaticus* in Plate VIII.

### PLECTOPTERA; EPHEMERIDÆ

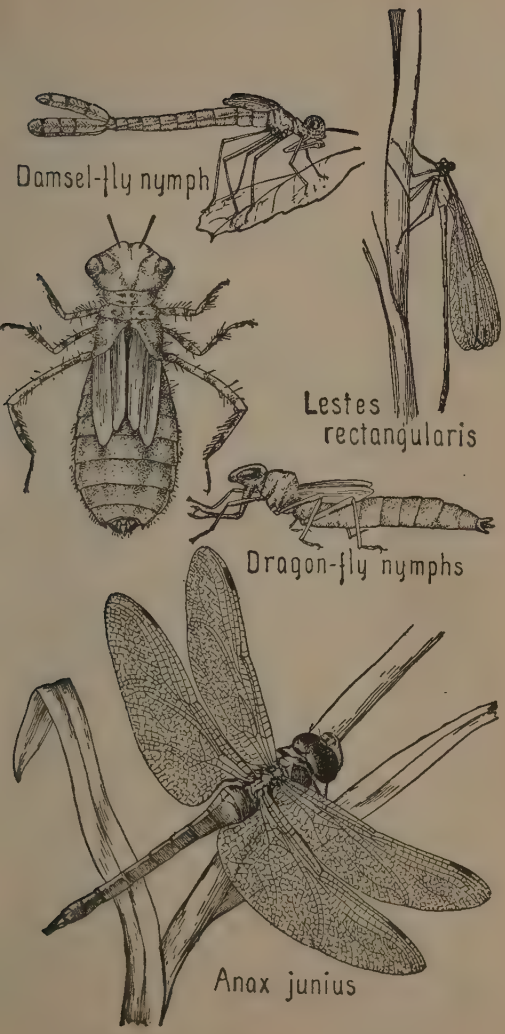
The family name of May-flies (see Plate VIII) comes from the same Greek root as does "ephemeral" and, although the term would fit the adult lives of most insects, it does forcibly apply to many of these, the three-weeks winged life of *Chlocon dipterum* being exceptional. However, though the winged stage may last but a day—or, better, a night—their lives from egg to adult are, insectly speaking, among the longest, some taking three years for their development. A female drops two packages, each of which may contain several hundred eggs, into the water; the packages break almost immediately and, after some time, there hatch from the eggs larvæ with gills along each side of the abdomen and three (as a rule) tail filaments. According to the species, these larvæ may swim rather freely, or make burrows in the mud, not swimming at all, or—the sort you are most likely to notice—crawl about on the under side of submerged stones. Some feed on vegetable matter; others are carnivorous. These larvæ molt frequently, twenty times having been recorded for one species, but the chief change is the gradual appearance of wing pads. The young of insects having, as these do, incomplete metamorphosis are usually called nymphs instead of larvæ, although this term is sometimes restricted to the stages in which the wing pads are quite evident. The full-grown nymphs crawl out of the water, frequently in crowds; the skin splits down the back of each and the freed creatures make short flights. But molting is not over yet. Nature loves exceptions, perhaps


Sminthurus
aquaticus
Lepisma
saccharina
domestica
Ephemera
varia
Nymph and Adult

"lest one good custom should corrupt the world," and these insects molt after they have obtained functional wings. The adult form is now reached and thousands may join in a joyous dance which often leads to an heirless death, if near human habitations, for they seem unable to resist the attraction of bright lights. Even under normal conditions some species dance a part of a night, mate, lay eggs, and die before morning. Fish eagerly devour the adults which fall on the water; and a favorite dry-fly, "gray drake," of fishermen is made in imitation of these insects. Plate VIII shows a typical form, *Ephemera varia*, but some species have much smaller hind wings or even none. The males have much larger compound eyes than have the females. There are about a hundred species in eastern United States, the identification of which is rather difficult. The ambitious student is referred to Bulletin 86 of the New York State Museum.

### ODONATA

The Dragon- and Damsel-flies have been called "Devil's Darning-needles" and accused of sewing up the ears of bad boys; "Snake-doctors" or "Snake-feeders" on the theory that they administered to the needs of reptiles; and "Horse-stingers" on the equally mistaken notion that they sting—since no human had ever been stung, horses must have been. As a matter of fact, they are dangerous only to other insects, but since Odonata have relatively strong biting jaws, the larger species may give you a gentle nip if you put your finger in their mouth. All members of this order live in water until they get wings and the aquatic young catch their prey in a very different manner from that practised by the aërial adults. The flying "dragon" darts back and forth with swift, well-controlled motions, scooping up its game in a "basket" formed by its six extended legs and the front of its thorax; the young, however, are sluggish and lie in wait for the unwary. When their chance comes, a curious thing happens: jaws seem to shoot out from the mouth and snap up the victim. Really, it is a jointed lower lip which is extended, and the "jaws" are hooks on its end (see Plate


Damsel-fly nymph
Lestes rectangularis
Dragon-fly nymphs
Anax junius

IX); the real jaws are attached near the base of this lip. Odonata have incomplete metamorphosis but the pre-adult stage, although active and showing wing cases, does not at all resemble the adult, differing in but little except size and the presence of wing-pads from its appearance when newly hatched. About 300 species are known in the United States. Bulletins 47 and 68 of the New York State Museum give technical keys by Needham for most of the species of New York as well as details concerning the curious sexual organs and other matters of interest.

## ZYGOPTERA

This suborder includes the Damsel-flies, those Odonata whose young breathe by means of three leaf-like gills placed at the hind end of their slender body; the adults, when at rest, hold the wings edge up and parallel with the body (see *Lestes*, Plate IX). They are not as strong fliers as are the "dragons," and they are more frequently seen flying tandem. In fact, a male often grasps with the pincers on the end of his body the thorax of a female and, flying in front of her, accompanies her on the egg-laying excursions, even going under the water with her when she descends to place eggs inside the stems or leaves of submerged plants. It seems to me that the males are of real assistance on such occasions: the legs of Odonata are not well fitted for walking so that it is difficult for them to crawl up through the water's "film" (surface tension); the joint efforts of both sexes gets the male through and he then uses his wings to pull the female out.

**Hetærina americana**

As will be seen in Plate X, only the male Ruby-spot is jeweled. Adults are to be found late in the season, fluttering about streams or clustered on the overhanging branches. The young cling to plants growing in the current or, sometimes, to those along the edge of large ponds.

**Lestes**

The members of this large, widely distributed genus (Plate IX) are usually abundant in marshes and about shallow pools which contain standing vegetation. Needham has noted that

♂
♀
Hetaerina
americana
Calopteryx
maculata
♀
♂
Perithemis
domitia
Libellula
pulchella

*L. unguiculata* places the eggs in aërial parts of plants which are growing in pools that usually dry up in mid-summer; the young, instead of hatching as soon as they are developed, stay inside the eggshell until the plants die, toward the end of the season, and drop into the now well-filled pool; development then goes on so rapidly that the adult stage is reached before the pool dries up the next summer. Probably, however, some of the species lay their eggs under water.

**Calopteryx maculata**

The figure in Plate X is that of a male Black-wing; the female has a white spot near the outer end of the front margin of the front wing and her wings are not so dark. Adults of this genus (probably *Agrion* is a better name) usually keep close to ditches or small streams in rocky woods. The female *maculata*, unattended by the male, lays her eggs in the submerged stems of aquatic plants. The young of this species have a light band on each leg and gill-plate.

## ANISOPTERA

Adults of this suborder, the Dragon-flies, when at rest, hold their wings flat and extended at right angles to the body. (See *Anax*, Plate IX.) The young do not have prominent external gill-plates but the lower intestine is thin-walled and they breathe by absorbing air from the water, which they draw in and expel through the anus. The young are stout-bodied in comparison with those of Damsel-flies, and, while the latter swim by sculling, using their gills as oars, the young Dragons shoot themselves forward by forcibly expelling the water from the rectum. This may be seen by placing one of them in a saucer with just enough water to cover the hind end of its body. The adults are, perhaps, the strongest fliers of all insects. There are two families, each with subfamilies not all of which are mentioned here.

### ÆSCHNIDÆ

The adults of the subfamily Gomphinæ are usually clear winged and have bodies striped black and green or

yellow; they do not seem to fly as much in pure sportiveness as do some of their relatives. The females, especially in June, skim the surface of ponds and streams, striking the tip of their abdomen into the water. At each dip gelatin-covered eggs are deposited; the gelatin dissolves; the eggs drop to the muddy bottom; and there, covered with silt, the wide, flat young lie in wait for their food.

Needham calls the subfamily Æschninæ "the largest, fleetest, and most voracious of our dragon flies." Many of them hunt well into twilight. The young are clean, slender-bodied, active climbers among green plants along the borders of ponds and streams. The following are two of the common species.

**Anax junius**

This species (Plate IX) is found in China, Siberia, throughout the Western Hemisphere from Alaska to Costa Rica, and in various Pacific Islands. The clear wings are at least two inches long; the thorax and head are bright green; and in front of the eyes is a round, black spot surrounded, first, by a yellow ring, and, then, by a ring of dark blue. The young are sure to be found by those who look for them and the dry shell, out of which the adult came during the night, is frequently seen clinging to the stems of plants which grow out of or near water.

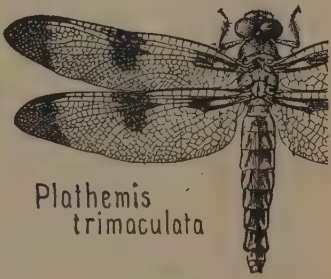
**Epiæschna heros**

This species (Plate XI) might be confused with *A. junius* except that it is larger and has a T-shaped, instead of a round, spot in front of its eyes. It is the largest of our dragons and one which frequently gets into buildings.

### Libellulidæ

Some of our commonest species belong here and they are collectively called Skimmers from their habit of sailing back and forth close to the ground or water. They frequently rest on bare branches or tall grass stems and seem ever ready to dart after a fly or to drive off another Dragon poaching on their preserve. The females do not place their eggs in plants but either drop them loosely or

Epiæschna heros



Plathemis trimaculata

Libellula semifasciata

hang them in gelatinous strings on aquatic vegetation. Such a string may contain more than 100,000 eggs.

**Epicordulia princeps**

This species (Plate XII) of the subfamily Cordulinæ is called Water-prince. It will test your skill with the net, as it is a splendid flyer and rarely at rest. Adults are to be found from May to midsummer along muddy, reed-grown banks. The young live on the bottom among detritus or on submerged logs. Not being good climbers, the nymphs usually seek a broad supporting surface, even some distance from the water, when they are ready to split down the back and free the adult. The female flies alone when depositing her eggs and makes her dips some distance apart in open water.

The remainder of the species mentioned here belong to the subfamily Libellulinæ.

**Perithemis domitia**

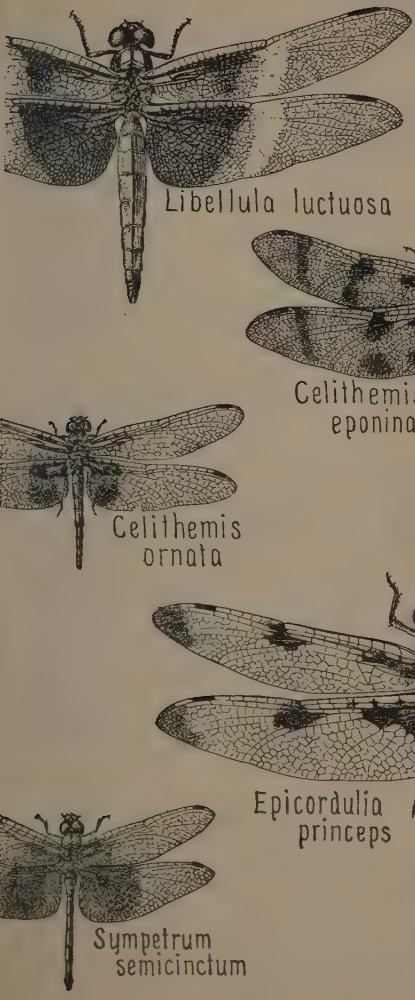
The Amber-wing is one of the smallest of our true dragon-flies and may be easily recognized by reference to Plate X. It flies, rather slowly and clumsily, in May and June, frequently resting, and hiding completely if a cloud but cover the sun.

**Libellula**

Individuals of this genus are common and conspicuous. The young are elongate, tapering, and provided with hairs which collect a concealing covering of silt. *L. pulchella* (see Plate X) frequents ponds; the females do not have the spaces between the spots so white as do the males. *L. semifasciata* (Plate XI) appears even before the middle of May, usually about woodland brooks. The basal portions of the wings of *L. luctuosa* (Plate XII) are brownish or black; the outer portions are clear except that the old males have the middle chalky white and the females have brownish tips.

**Plathemis trimaculata**

This frequenter of ponds and ditches, the White-tail (Plate XI), usually holds its wings slanting forward and downward when at rest. The females and young males have the


Libellula luctuosa
Celithemis eponina
Celithemis ornata
Epicordulia princeps
E.L.B.
Sympetrum semicinctum

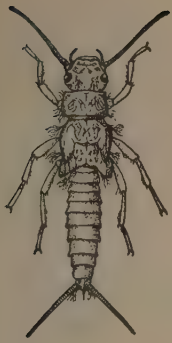
brown body marked with yellow, but the old males are powdered with white.

**Celithemis** Three of our most beautiful small species belong to this genus. *C. eponina* (Plate XII) is adult in late June and early July along the borders of ponds and in the neighboring fields. *C. elisa* has a small rounded spot of brown on each front wing just beyond the place where *eponina* has a brown band. *C. ornata* (Plate XII) is found along the Atlantic coast from Maine to Florida.

**Sympetrum** Many of the species of this large genus have brilliant red bodies. They frequently fly far from their marshy home. The only one of our common species which has wing markings is *S. semicinctum* (Plate XII).

## PLECOPTERA

All observant trout fishermen have noticed on the stones in rapid streams hordes of flat larvæ (nymphs) clinging tightly or scuttling from place to place. They usually belong to this group (see Plate XIII), as may be told by the two tail filaments, two tarsal claws and the thread-like gills, if any, at the bases of the legs. There is only one family, PERLIDÆ, the common name being Stone- or Salmon-flies. They never have gills along the sides of the abdomen, although there may be gills at the bases of the tail filaments; the thoracic gills are not large and the smaller species have none at all, depending upon the thinness of the skin on their underside for the transfer of oxygen. Since the breathing apparatus is so poorly developed, they are largely confined to well-aërated water. They feed upon other aquatic animals and are eagerly eaten by trout, making excellent wet bait. Especially during the first warm days of spring, the full-grown nymphs crawl out on stones or logs and the adults leave the nymphal skin, which, complete even to the lining of the main tracheæ and of the fore-gut, is hooked to the molting place. The adults are gray or greenish, usually with two



Plecoptera

♀

♂

Corydalis cornuta

tail filaments, hind wings larger than the front ones and, in some cases, with curious reminiscences of their former life in degenerate gills at the bases of the legs. A single female may lay as many as 6,000 eggs, dropping them either promiscuously into the water or done up in a loose packet. Less than a hundred species have been described from North America.

### MEGALOPTERA

This "pigeon-hole" in the classification of insects contains the former Neuropterous family Sialididæ. As an Order, it now has two families of its own: SIALIDIDÆ (in a limited sense) and CORYDALIDÆ. Before telling about the only species concerning which I have actually been asked by laymen, I will slip in a few words about some of its relatives. This order is probably more primitive than Neuroptera and its members differ from Neuroptera in having the hind wings broad at the base and folded, fan-like, when at rest. Species of *Sialis* (the only genus in Sialididæ) are called Alder-flies or Orl-flies and differ from other members of the order in having no ocelli. Their larvæ are aquatic; carnivorous; each of the first seven segments of their abdomen bears a pair of five-jointed appendages, and a similar (but longer and un-jointed) appendage forms a kind of tail. The larvæ live buried in the bottom of streams but they crawl out and bury themselves in above-water earth to pupate—all Megaloptera have complete metamorphosis and so do pupate. The Corydalidæ differ from the Sialididæ by having three ocelli, when adult, and two hooked fleshy projections, instead of a single "tail," on the hind end of the abdomen of the larva. The family is divided into genera, two of which concern us: *Chauliodes*, in which the adults have the hind corners of the head rounded, and the larvæ have no hair-like tufts at the bases of the lateral filaments of the abdomen; and *Corydalis*, in which the adults have the hind corners of the head sharply angled and the larvæ have hair-like tufts at the bases of the lateral filaments. The species of *Chauliodes* are called Fish-flies. The adults are grayish or brownish, with whitish

spots or bands, and have feathered antennæ. The larvæ are aquatic, but do not favor swift streams. Pupation takes place out of the water, in rotten logs or in the earth. Now we come to the creature laymen ask about.

**Corydalis cornuta**

I can not give all the nicknames and have no preference; some of those I have heard are Dobson-fly, for the adult, and, for the larvæ, Hellgrammite, Dobson, Crawler, Hell-devil, Hell-diver, Conniption-bug, and Arnly. Others have been published, but when I read this short list to my ten-year-old she said "It must be an awful-looking thing." Whatever its appearance (Plate XIII), the larvæ make irresistible bait for bass and many of us have turned over stones in swift streams looking for them with that end in view. In the May or June that the larvæ are full-grown, a matter of probably three years, they crawl out on the bank and pupate under stones, the adults emerging several weeks later. Now, the male is not as terrible as he looks. Those long jaws are to embrace the female when mating. The female's jaws are short, stubby and much more likely to pinch. Two to three thousand eggs are laid in a whitish, rounded mass on a leaf, or some other object, which overhangs a stream.

## NEUROPTERA

As previously mentioned, the Sialididæ and Corydalidæ are considered by many authorities to be Neuroptera. Neuroptera, in a limited sense, are not only terrestrial but, in some cases, inhabitants of the dryest deserts. Metamorphosis is complete. There are eight or ten interesting families but members of only two of them are commonly noticed by laymen.

The following is a key to certain of the Neuroptera.

1. **Antennæ** enlarged toward the tip; club-shaped, or with a terminal knob.....MYRMELEONIDÆ.

**Antennæ** without terminal enlargement.....2.

2. **Front** legs fitted for seizing prey, stouter than the other legs; attached to the front end of an extremely long prothorax. Some, at least, of the larvæ live parasitically

in the nests of spiders and wasps, and pupate there within a silken cocoon.....MANTISPIDÆ.

**Front** legs not thicker than other legs and not fitted for grasping.....3.

3. **Wings** with few, simple veins, and covered with a whitish powder. Minute and rare insects whose larvæ feed on aphids.....CONIOPTERYGIDÆ.

**Wings** with many veins and not covered with whitish powder.....4.

4. **Wing-veins** all ending in a succession of symmetrical forks. CHRYSOPIDÆ (antennæ threadlike) and HEMEROBIDÆ (antennæ either like a string of beads or comb-like).

**Wing-veins** meeting the outer margin of the wing in straight lines. Insects now put in the order **Megaloptera** (p. 52).

**Myrmeleonidæ**

The "common" name, Ant-lion, given to members of this family is a translation of the real name and both are poor, for one could scarcely imagine a lion digging a trap in which to catch its prey. The ant-lion's trap is ingenious; it is a pit made in sand or loose soil. The larva is hidden at the bottom (see the cross-section shown in Plate XIV). When an ant or some other insect steps over the edge, it tumbles into the waiting jaws below, often being assisted in its downfall by a shower of sand thrown up by the hidden lion. Pupation takes place, underground, inside a spherical silken cocoon. The adults are delicate, gauzy-winged creatures which are frequently attracted to lights; in fact, they were so common as to be troublesome one summer when I was collecting moths in the arid Southwest. A favorite place for the pits of some species is underneath shed roofs.

**Chrysopidæ**

In his *Book of Bugs* Harvey Sutherland says of the Aphis-lion: "Its mother, the golden-eyed lace-wing fly, is a dear, sweet thing, that you would think fit only to go on an Easter card, so pale and æsthetic are her light-green wings. But her children are such regular little 'divvels' that she dare not lay her eggs in one mass, for the first one out would eat up all the rest. So she spins a lot of stalks of stiff silk and sticks one egg

Chrysopa

Myrmeleonia

on the end of each, thereby giving each young one a chance for its life." The captious would remark that a given egg and its stalk are arranged before another stalk is made, but the final effect is the same (see Plate XIV). The principal genus of this family is *Chrysopa*, including about a dozen species in most parts of the country but the species all look pretty much alike. They come every year on my honeysuckle and I bring more from the fields and turn them loose in my garden. I have never considered, carefully, the moral side of such an action but I am sure the owners of the "fields" would tell me I was welcome if I showed them the *Chrysopa*—they wouldn't know what a splendid help these insects are in keeping down aphids (plant lice). One Sunday afternoon I tried to see how many such pests a single *Chrysopa* would eat; I have forgotten what the count was when I stopped but I know that I got tired before the aphis-lion did and I turned it loose on the honeysuckle to keep up the good work. The larva spins a delicate silken cocoon in which to pupate; the cocoon opens like a box when the adult is ready to emerge. The odor of the adult is not always as delicate as the appearance; they are sometimes common about lights so that you can easily determine this yourself.

The larvæ of HEMEROBIIDÆ are also "aphis-lions"; the adults have brownish or smoky wings instead of greenish.

## MECOPTERA

Adult males of the genus *Panorpa* (see Plate XV) have a pair of claspers at the end of their abdomen by means of which they hold the females while mating. These claspers and the turned-up slender body suggest the sting of a scorpion, hence the common name Scorpion-flies, but they are harmless. The larvæ, as far as known, are carnivorous and live on or just below the surface of the ground, especially if it be moist. All the adults of this order have beak-like mouths and, if they feed at all, are probably carnivorous. Certainly, adults of *Bittacus* (Plate XV), although they look something like craneflies with too many wings and appear to be asleep much of the time, wake up

in time to catch unwary flies; but the small (less than .25 in. long) species of *Boreus*, which have no wings and are found on the snow in the Northern States, must find poor picking there.

## Trichoptera

These insects have an incidental interest in being near to the ancestors of butterflies and moths, but they need no reflected glory to give them an appeal. They have complete metamorphosis, and, although the adults are aërial, the larvæ and pupæ are aquatic. The name of the order signifies "hairy winged"; the hair is, however, often difficult to see without a lens and sometimes it is almost as scale-like as in some Lepidoptera. The adults are frequently attracted to our porch lights, with many people passing for moths that hold their wings trimly against the sides of their bodies and have very long antennæ. The larvæ are popularly called Caddice- or Caddis-worms—the term coming from a German word for "bait" because they were used for that purpose. In these days of dry flies the adults serve as models for such favorites as the Duns. Most of the larvæ make portable houses for themselves (see Plate XV). *Phryganea interrupta* and *Platycentropus maculipennis*, both living in still water, use light material, the former clipping pieces of leaves and neatly fastening the edges together, the latter cutting small sticks in short lengths and arranging them crossways of its body. *Molanna cinerea*, *Notidobia americana* (case, a narrow cone), *Psilotreta frontalis* (a similar case but blunter, nearly cylindrical), and *Helicopsyche annulicornis* all live in running water and build of sand. *Halesus argus* also lives in running water but weights the case of sticks with stones and shells, not always being careful to select unoccupied shells either. In these and many other such instances, the larvæ go about with only their heads and legs sticking out of their homes and are ever ready to withdraw even those on approach of danger. The materials used in constructing the cases are fastened together with silk; when time for pupation comes, the whole case is anchored with silken cords to some under-

water support, the ends are covered with a loose silk netting and the change occurs in the privacy of the larval home. *Polycentropus lucidus* builds a stationary, tunnel-like dwelling in the silt where the current is slight and species of *Hydropsyche* build stone ones, which are anchored to larger stones in places where the current is swift. With the possible exception of *Hydropsyche*, caddice-worms seem to be vegetarians. *Hydropsyche* may be carnivorous and *Hydropsyche analis* has long been an object of interest with those who know. Its larva lives in the very swiftest of streams in a rather rude, but firmly fastened, hut of pebbles and debris; not far from its door it makes a net (see Plate XV) between small stones or on the top of some large stone where it is in the current's sweep. This net is always placed across stream and its top is often framed with sticks. Now all *H. analis* needs do, when hungry, is to go out of its hut and eat whatever food the net has caught. On such excursions it keeps hold of a strand of silk which has one end fastened to the door so that it can pull itself back if the current should loosen its footing. Pupation takes place in the larval dwelling, but how about the adult? Most insects slowly work their way out of the pupal case and then rest for some time until their wings are dry and strong. This would never do for *H. analis*, nor for many other species of Trichoptera, since fish would snap them up even if the current did not overpower them. It is said that the pupa leaves its protective case, swims to the surface, and instantly the adult shoots out of the pupal skin and flies away.

The classification of adult caddice-flies is not easy and, as the chief interest is in the larvæ, the following key, based on larval characters, is given. It is a modification of one in Bulletin 47 of the N. Y. State Museum and includes the principal families.

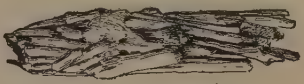
1. **Head** bent downward at an angle with the body; tubercles usually present on the basal abdominal segment; gill filament, when present, simple (except in some Limnophilidæ), lateral fringe usually present.....2.

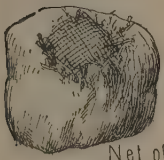
**Head** in line with the main axis of the body; tubercles and lateral fringe absent; gill filaments, when present, branched.....5.

Bittacus strigosus

Panorpa nebulosa

Mantispa brunnea



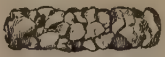


Net of Hydropsyche

Halesus argus

Molanna cinerea

Platycentropus maculipennis



Phylocentropus lucidus

Helicopsyche annulicornis

Phryganea interrupta

Caddice Cases

2. **Hind** legs not more than twice as long as the front legs ..... 3.

**Hind** legs more than twice as long as the front; abdominal constrictions slight. Cylindrical case of sand and small stones ..... LEPTOCERIDÆ.

3. **Head** longitudinally elliptic, at slight angle with the body; only head and pronotum chitinized; abdominal constrictions deep; hind legs slightly longer than the front. Case of vegetable matter laid longitudinally and forming a spiral, widening at the anterior end ..... PHRYGANEIDÆ.

**Head** oval to round; usually more of the thorax than the pronotum chitinized; abdominal constrictions slight.. 4.

4. **Lateral** fringe well developed. Cases various..... LIMNOPHILIDÆ.

**Lateral** fringe slightly developed. Case of sand or small stones ..... SERICOSTOMATIDÆ.

5. **Abdomen** much thicker than the thorax. Case kidney-shaped, of small stones; or flat and parchment-like ..... HYDROPTILIDÆ.

**Abdomen** little, if any, thicker than thorax..... 6.

6. **Hind** legs about the same length as the front ones. No portable larval case..... HYDROPSYCHIDÆ.

**Hind** legs a little longer than the front ones. No larval cases ..... RHYACOPHILIDÆ.

**The Ancestral Tree**

The ancestral tree of insects is buried to beyond the origin of the branches in the oblivion of the past. We have been looking at the lower part of certain branches and on one of them we got rather close to the roots when we were examining "the most primitive insects." Partly for convenience, but also because the branches are so tangled and their points of union are so hidden, we have not kept to a single branch. When we were at the Trichoptera, we were near the point where one of them blossoms out into Lepidoptera. It is believed that incomplete metamorphosis is one of the signs of primitiveness and we will now go down near the trunk again but in another part of the tree. Rather than start with forms not usually noticed by any but professionals, we will begin with earwigs:

### Dermaptera

The name of the order alludes to the skin-like, really leather-like, front wings. Another name which is sometimes used is Euplexoptera and alludes to the skill with which they fold their hind wings. Grant Allen, in his essay on *Those Horrid Earwigs*, has written entertainingly of this matter. They sometimes come to porch lights but are not really common with us. Of the nickname, Allen says: "It is called earwig, gossips will tell you, because it creeps into the ears of incautious sleepers in the open air, and so worms its way to the brain, where, if you will believe the purveyors of folk-lore natural history, it grows to a gigantic size, 'as big as a goose's egg,' and finally kills its unhappy victim. It is true, science knows nothing of this form of brain-disease; it has tried the case before an impartial tribunal and the earwig has left the court without a stain on its character."

Earwigs are easily confused with Staphalinid (and some other) beetles because the front wings of neither cover the body, but earwigs may be distinguished by their having pincers on behind (compare Plates XVI and LXXV). These insects are nocturnal; by day they live under stones, in decayed wood, in earthworm burrows and the like. It seems to be a mistake about their feeding on plants; they are probably entirely carnivorous and go on plants to look for dead or living insects to eat. The mother sits on a cluster of eggs like a brooding hen in order to guard them, not for incubation since insects are "cold-blooded." The young resemble their parents except that they have no wings and they are said to stick rather closely to mother for some time after they are hatched. All the common species in the Northeast are transatlantic introductions. *Anisolabis maritima* measures nearly, or quite, an inch in length when adult and lacks wings. It is found under the wash-up on the sea beach. The antennal joints of *Forficula* are cylindrical; *auricularia*, common in England, is one of several species found in greenhouses here. The antennal joints of *Labia minor* (Plate XVI) are wider at the apices than at the bases; it is our most common inland species.

## ORTHOPTERA

For the sake of simplicity, and to conform with other books you may see, we will include roaches, mantids, and walking sticks in this order, calling them families, although good authorities consider each of them to be a separate order. The earwigs were formerly classed as Orthoptera but are now generally conceded the rank of an order. All have incomplete metamorphosis. A useful paper for students in the Northeast is by B. H. Walden, Bull. No. 16, State Geol. and Nat. Hist. Survey of Connecticut.

### BLATTIDÆ

These are the Roaches. I like the spirit in which Sutherland views these none too well liked creatures: "If the test of nobility is antiquity of family, then the cockroach that hides behind the kitchen sink is the true aristocrat. He does not date back merely to the three brothers that came over in 1640 or to William the Conqueror. Wherever there have been great epoch-making movements of people he has been with them heart and soul, without possessing any particular religious convictions or political ambitions. It is not so much that he approves of their motives as that he likes what they have to eat. Since ever a ship turned a foamy furrow in the sea he has been a passenger, not a paying one certainly, but still a passenger. But man himself is but a creature of the last twenty minutes or so compared with the cockroach, for, from its crevice by the kitchen sink, it can point its antennæ to the coal in the hod and say: 'When that was being made my family was already well-established.'"

**Blattella germanica**

This hyphenate was named by Linnæus long before *the* war and he probably did not mean to insinuate anything, although certain "scientific gents" have played such tricks. As a

Labia minor

Periplaneta americana

Blattella germanica

P. australasiae

Blatta orientalis

matter of fact, this household guest probably accompanied our ancestors when they moved into Europe from Asia. It got the name of Croton-bug because it first attracted general attention in New York about the time Croton water was put in. Perhaps the most interesting thing about the species is the way the mother carries around her package of eggs sticking out of the hind end of her body (see Plate XVI).

**Blatta orientalis**

Linnæus is responsible for the geographic name of this species too, and also of the next and the next. He was a sort of Mrs. Wiggs. Only the male of the Oriental Roach (Plate XVI) gets functional wings—a rather common arrangement among insects and one which does not seem quite fair as it means that the lady must walk when she wishes to establish her family in a new place. Perhaps the "black beetle" (!) did start from the Orient; like most of the roaches which are directly associated with man, it is now cosmopolitan.

**Periplaneta**

This genus is occasionally brought to our attention by the large, trim *P. americana* (Plate XVI, which also shows an egg-capsule) from the South. Sometimes we see *P. australasia*, not so elongate and wearing yellow shoulder stripes lengthwise of its front wings.

Those who go afield find species of *Ischnoptera* under loose bark, independent country folk which never live in towns. In the tropics, there are not only roaches which are much larger than ours but also species which seem more beautiful to us; one such genus is *Panchlora* (Plate XIX), members of which frequently make the trip north in bunches of bananas. By the way, in addition to eating our food, clothing, etc., roaches help us kill our bedbugs, if we have any.

### Mantidæ

One of the favorite attitudes (see Plate XVII) of these creatures is supposed to be devout and has given them the name of "Praying Mantids." I hate to go against

Stagmomantis carolina
A Phasmid
(Manomera)

authority but the pose does not seem to me devout and I know that the mantis is seeking whom it may devour; see those big eyes and especially those spines on the jaw-like front legs. Please do not accuse me of punning when I suggest that they be called "Preying Mantids." Other names are Devil's Rear Horses and Soothsayers; while, in the South they are believed to poison stock with the brownish fluid from their mouths and are called Mule-killers. They are the only insects that can look over their shoulders. Our northern native species (*Stagmomantis carolina*) does not get farther north than southern New Jersey. It is 2 or 3 in. long; the males and some females are grayish brown except for the body and feet which are sometimes greenish; the females may be wholly green. The egg-mass shown in Plate XVII is a trifle small. The European *Mantis religiosa* has apparently established itself in central New York. Including the wings which extend beyond the tip of the abdomen, it is about 2½ in. long; it is either brown or green. The Oriental *Paratenodera sinensis* is now fairly common about Philadelphia and is being introduced into other parts of the country. It is quite large, especially the female, attaining a length of 3½ in. or more; the broad, green, front margin of the front wings is sharply separated from the much larger brown portion. The egg-mass of *sinensis* is shaped like a short, broad cornucopia; the eggs are protected by a brownish substance somewhat like dried foam. Several other species occur in the South. All are very beneficial since they destroy large numbers of injurious insects. They are quite harmless to man and, indeed, make good pets.

### Phasmidæ

In the tropics, where this family, the Walking Sticks, is at home, many of the species have wings, but the northern representatives, *Diapheromera femorata* and *Manomera blatchleyi*, are wingless—sticks without leaves (see Plate XVII). These curious insects, which may be either brown or green, are not really rare as far north as New York, but, as they look so like twigs and never fly, they

are rarely seen by the layman except when they are so unusually abundant as to be destructive. They feed on the leaves of almost any sort of tree. The shot-like eggs are dropped singly and promiscuously to the ground where they lie over winter, or possibly over two winters. I once found these insects so abundant in a Pennsylvania locality that the trees were all but stripped of leaves and the dropping eggs sounded like rain.

The remainder of the Orthoptera typically have the hind femora enlarged and thickened for leaping.

### Acrididæ

By remembering that the antennæ are always much shorter than the body, one has no difficulty in recognizing this family of Grasshoppers. The migratory Rocky Mountain Locust (*Melanoplus spretus*), which occasionally has been so destructive in our West, and the Biblical locusts, which were eaten with wild honey, belong here. Some species make a rasping sound by rubbing their hind legs against their front wings (tegmina); others rattle, while flying, their hind wings against the tegmina. These sounds are primarily amorous serenades and Nature's serenades without attentive ears would be even more curious than the ears for which the grasshoppers perform. In this family there is an auditory organ on each side of the first abdominal segment, just above and back of the places where the large hind femora start. Notice the clear round spot on the next grasshopper you catch. Short-horned grasshoppers, as a rule, lay their eggs in clusters, underground (Plate XVIII); perhaps you have noticed, in the fall of the year, females along the path with their abdomens sunk to the base in a small hole which they had made by pushing aside the earth.

**Tettiginæ** These small grasshoppers, the Grouse Locusts, are distinguished from their relatives by their pronotum extending back to, or beyond, the tip of the abdomen. There are numerous species, some of which are quite variable and one of which (*Acrydium ornatus*) is shown in Plate XVIII. Four genera may be separated as follows:

Grasshopper
Egg Mass

Acrydium ornatus

Schistocerca americana

Truxalis brevicornis

Spharagemon bolii

1. **Antennæ** with 21 or 22 joints.....*Tettigidea.*
   **Antennæ** with 12 to 14 joints.....2.
2. **Pronotum** with a high, arched, median longitudinal ridge.....*Nomotettix.*
   **Top** of pronotum rather flat, median ridge low.....3.
3. **Vertex** of head not projecting beyond the eyes. *Paratettix.*
   **Vertex** of head projecting in front beyond the eyes....4.
4. **Pronotum** reaching to the eyes.....*Neotettix.*
   **Pronotum** not reaching the eyes.....*Acrydium.*

**Truxalinæ or Acridinæ**

It is difficult to distinguish, in all cases, with certainty between this and the next subfamily. The Truxalinæ have no spine on the prosternum (or at most an oblique tubercle) and they typically have receding chins. Plate XVIII shows a rather extreme type, *Truxalis brevicornis;* the antennæ are flat at the base and pointed at the apex; side ridges of pronotum straight; general color either green or brown. This species inhabits moist places. *Pseudopomala* also has flattened antennæ and a very oblique face but its prosternum has an obtuse tubercle. In *Eritettix* the antennal joints just before the end are thicker than the others and the apical spur on the inner side of the hind tibiæ is twice as long as the other spur. In *Mermiria* the space between the mesosternal lobes is almost linear in its narrowest part and the metasternal lobes touch. Some other genera (in which, as in these, the head is shorter than the pronotum and not distinctly elevated above it, may be separated as follows:

1. **No** small depressions ("foveolæ") on the upper surface of the head between and in front of the eyes or, if present, invisible from above; face very oblique.....2.
   **Such** foveolæ present and visible from above; face less oblique.....5.
2. **Hind** tibia with 18 to 21 spines on the outer margin. *Syrbula. S. admirabilis:* male, about 1 in. long; ground color usually brown; yellow on face, base of antenna, an oblique line from each eye, lower sides of pronotum and parts of hind femora. The female is about 1.5 in. long;

usually greenish ground-color; a reddish brown stripe, bordered with black, extends from top of head to back of pronotum.

**Hind** tibia with not over 15 spines on outer margin...3.

3. **Antennæ** about, or more than, 1.5 times as long as head and pronotum together; a median ridge on upper front of head. *Chlœaltis. C. conspersa* has yellowish or brown general color; length, nearly 1 in.; front wings of female only about half as long as abdomen. Eggs are laid in soft wood.

**Antennæ** shorter; no such distinct ridge.....4.

4. **Upper** margins of sides of pronotum longer than sides are wide, and parallel. *Dichromorpha.* The general color of the male *viridis* is dull brown and the length is about .7 in.; the female is either brown or bright green and at least 1 in. long; front wings usually not as long as the abdomen.

**Sides** of pronotum relatively broader and top margins squeezed together in the middle.....*Orphulella.*

5. **Median** ridge of pronotum rather high and sharp, cut plainly in front of middle.....*Mecostethus.*

**Median** ridge not so.....6.

6. **Apical** spurs on inner side of hind tibiæ equal in length; ridges on sides of top of pronotum distinct throughout. *Chorthippus.* Our common species is *curtipennis.*

**Lower** apical spur about twice as long as the upper; side-ridges distinct only in the middle. *Ageneotettix.* Not common east of the Mississippi.

**Œdipodinæ**

These differ from the preceding subfamily in not having, as a rule, such receding chins; some of them differ from other grasshoppers in having parti-colored hind wings, and some in also having crests on their pronotums (see Plate XVIII). They are the ones which make a noise when they fly and sometimes a male will hover in the air above a female and rattle away for dear life, meanwhile showing off his gay hind wings. When at rest on the ground, with the hind wings covered, they are very difficult to see because of their protective coloration. *Dissosteira carolina* (Plate XIX) is one of the commonest species; the color of its tegmina varies

from blackish, through brown and reddish, to yellowish. The sand-colored species, with pale yellow and black hind wings, so common on the shores of the Atlantic and of the Great Lakes, is *Trimerotropis maritima*. In *Arphia* the crest is not notched. In *Psinidia* (antennæ of male longer than the hind femora, basal joints strongly flattened; our common species is *fenestralis*, whose black-bordered hind wings vary from pale yellow to red), *Trimerotropis*, and *Circotettix* (hind tibiæ dusky towards base and at tip), the crest is notched twice. Some of those with only one notch are:

1. **Disk** of hind wing nearly transparent, uncolored.....2.
   **Disk** of hind wing opaque or colored.....3.
2. **Pronotum** roof-shaped and front margin angulate. *Chortophaga*. Our common species is *viridifasciata;* it may be either green or brown.
   **Pronotum** flat on top except for the prominent crest which is higher in front than behind; front margin of pronotum square-cut. *Encoptolophus*. In *sordidus* the base of the hind wings is yellow; hind tibiæ with a pale ring near the base.
3. **Body** robust; lateral ridges of pronotum extending in front of the principal groove and not cut by it. *Hippiscus*.
   **Not** so.....4.
4. **Hind** wings black with a pale border....*Dissosteira*.
   **Hind** wings yellow at base with a dark median band. *Scirtetica marmorata* (tegmina marbled with grayish and dark blotches; hind femora dark at apex and with 3 dark bands) and *Spharagemon* (Plate XVIII).

**Locustinæ**

Acrididæ with the pronotum not extending to near the tip of the abdomen but with a prominent spine on the prosternum (the underside of the first segment of the thorax) are grouped in this subfamily. There are numerous species and even the common ones cannot be satisfactorily differentiated without going into technicalities. *Schistocerca americana* (Plate XVIII) is one of the largest in size and strongest in flight of our grasshoppers; another species is called *damnifica*, a name which sounds good to him who chases these "Bird-locusts"

in the hot sun. *Melanoplus femur-rubrum* is the extremely common, red-legged grasshopper of our fields, very similar to *M. spretus*. The fat, clumsy, short-winged "Lubber Grasshopper" of our Southeast is *Romalea microptera* and the almost wingless Lubber of our Southwest is *Brachypeplus magnus*.

1. **Tegmina**, especially of females, over an inch long. *Schistocerca.*

**Tegmina** rarely an inch long.....2.

2. **General** color green, in life; the least distance between the eyes less than 1½ times the width of the second antennal joint. *Hesperotettix*. The least common of these four genera.

**Usually** brownish; eyes more widely separated.....3.

3. **Dorsal** surface of pronotum not twice as long as the average breadth, the sides constricted at the middle. *Melanoplus.*

**Dorsal** surface of pronotum relatively longer, the sides not constricted at middle.....*Paroxya.*

### Tettigoniidæ

A proper nickname for the Acrididæ is "Locusts." This used to be very confusing since the scientific name of the long-horned grasshoppers, which are not "Locusts," was Locustidæ. It was recently discovered by some of those whose business it is to find out such things that "Locustidæ" is not good usage. The matter is still *sub judice* but I prefer the less confusing one. The Long-horned Grasshoppers may be distinguished from crickets (Gryllidæ) by the fact that their wing-covers slope down on the sides and are not flat above except for a short space near the base. Both families have long antennæ; the males of both sing or, better, fiddle by rubbing their wing covers together; and both listen with "ears" which are situated near the upper part of the tibiæ of their front legs.

Among those genera having hind wings, *Scudderia* (tegmina of nearly equal breadth throughout) and *Amblycorpha* (tegmina widened at the middle) have no spines on prosternum or vertex but have one on each side of the

tip of the hind tibiæ. In *Pterophylla* the tegmina is broadly expanded in the middle and the pronotum is crossed by two distinct grooves.

**Pterophylla camellifolia**

Few have not heard the masculine debates as to whether Katy did or didn't, but many do not know, by sight, either the disputant or Katy, both of whom usually stay high in trees. Plate XIX shows the male; the musical apparatus is at the base of the tegmina, and the leaf-like wing-covers themselves, broadly curving entirely around the body, act as sounding boards. The female's wing-covers do not have the thick rasp-veins at their bases; and at the hind end of her abdomen is a stout scimitar-like ovipositor with which she places her eggs in the bark of various trees. In many of the older books this species is called *Cyrtophyllus concavus*, and has been nicknamed the True Katydid.

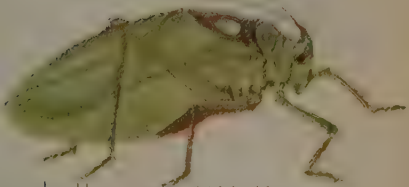
**Amblycorypha oblongifolia**

The "folia" part of the scientific name refers to the leaf-like appearance of the front wings. Nearly all of the Katydids are typically green, but, like some other green insects, they, and especially this species, have brown or pink "sports" (see Plate XIX). The figure is of a female and shows the ovipositor. The "Oblong-leaf" and the other relatives of the True Katydid often live in low bushes.

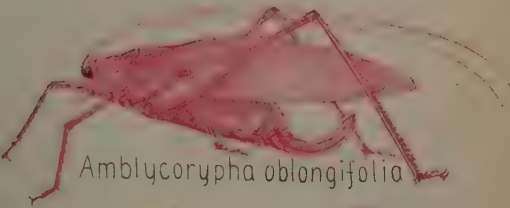
**Meadow Grasshoppers**

Under this general head we may group numerous species of *Neoconocephalus* (rather large, green or brown species, with the front of the head more or less prolonged into a cone, and with spines on the underside of the front and middle femora), *Orchelimum* (usually an inch, or slightly more, long; females have stout and curved or sickle-shaped ovipositors), and *Conocephalus* (smaller, as a rule; the ovipositor is slender and straight; prosternal spine very short; see Plate XX). Some authors class *Neoconocephalus* with Katydids rather than with Meadow Grasshoppers and, as a matter of fact, these insects are rather partial to bushy fields. The name *Conocephalus* is apt to cause some trouble to those who consult books which were

Dissosteira carolina



Pterophylla camellifolia



Amblycorypha oblongifolia

Œcanthus

Panchlora

published more than several years ago; it refers to what is called in them *Xiphidium*, and *Conocephalus* in such books refers to what should be called *Neoconocephalus*. The members of all three genera have the habit of dodging around to the other side of the grass-blade or weed-stalk when you approach, rather than trusting to flight. They place their eggs, by means of their sharp ovipositors, in the leaves of grasses, pith of twigs, and in similar situations.

**Wingless Grasshoppers**

All grasshoppers are wingless when they are young but the members of certain genera do not get wings even when mature. *Ceuthophilus* (see Plate XX) is the most common genus, especially in the Northeast, and its members have been nicknamed "Cave Crickets"; but they are not crickets and, while some species live in caves, the majority live in cellars, under the floors of out-buildings, under stones, in hollow logs, and the like. For some reason they are also called "Camel Crickets." *Atlanticus* is a genus usually found under fallen leaves in woods; its male members still retain remnants of the front wings, and, by using these, they are able to make sounds. Kellogg says of the "Jerusalem Crickets" (*Stenopelmatus*) which live on the Pacific Coast that they are large, awkward, thick-legged creatures with "baby-faces."

### Gryllidæ

One of the points of distinction between the long-horned grasshoppers and Crickets was given in the discussion of Tettigoniidæ; another is that the ovipositors of crickets, when long, are needle-like. The musical apparatus of the males (see Plate XX, which shows also an "ear" on a front leg) occupies a relatively larger portion of the wing-covers than it does among the Tettigoniidæ. Many of the species, especially of *Nemobius*, *Gryllus*, and *Gryllotalpa*, occur in two forms: one with short, and one with long, functional hind wings.

**Gryllotalpa**

These creatures, the Mole-crickets (Plate XX), have curiously enlarged front legs, which are used in excavating their burrows; the hind

femora are slender. These insects are almost never seen above ground except at the mating season when they are sometimes attracted to lights. They usually live in rather damp soil and, in some countries, do great damage by eating the roots of seedling crops; this is true of the "Changa" in Porto Rico. The female has no prominent ovipositor but places her eggs in a loose pile in her burrow.

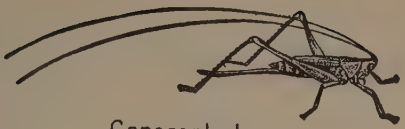
A related genus, *Tridactylus*, contains species less than .4 in. long; the front tibiæ are not broadly expanded but have three or four spines at the apex; hind femora slender; tarsi with only one joint.

**The Field Crickets**

The large, black species belong to the genus *Gryllus* (Plate XX); the usually more numerous, small, brown species are *Nemobius*. The males of both chirp by rubbing the file on the under side of one wing against the roughened surface on the upper side of the other. *Nemobius* is almost altogether vegetarian but I have never quite forgiven the omnivorous *Gryllus* for eating holes in a bathing suit which was left on the beach to dry. Both genera place their eggs singly in holes which they make in the ground with their sharp-pointed ovipositors. *Gryllus* is relatively tame; and not only may you watch the male chirping in a desultory fashion near his retreat (such as a burrow or under an old board), or angrily challenging another male to battle, or passionately entreating a female, but you may make pets of them. A lantern globe set on soil in a flower pot makes a good cage; feed them lettuce, moist bread and, especially if you have a numerous family the members of which are inclined to eat each other, some bone meal; if you wish to incubate the eggs, water the soil about as you would for plants. Most of the individuals pass the winter as eggs but some hibernate as almost-mature nymphs. The "Cricket on the hearth" is a light-colored European species (*Gryllus domesticus*) which is sometimes found in greenhouses and dwellings in this country.

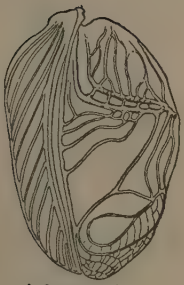
**Œcanthus**

There are numerous species of these delicate, greenish or greenish-white musicians, the Tree-crickets. One of the principal specific

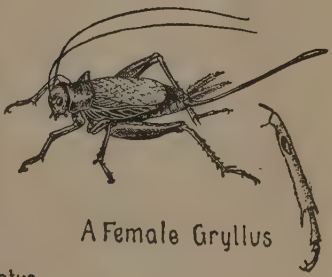


Conocephalus

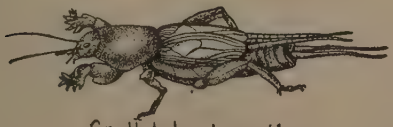
Ceuthophilus



A Cricket's Musical apparatus



A Female Gryllus



Gryllotalpa borealis

characters is the shape and arrangement of the black dots on the two basal joints of their antennæ. However, as is the case with other groups of Orthoptera, each species has a tune of its own (the *tempo* depending on whether it is night or day, sunshiny or cloudy, warm or cold). Some students have become so expert in Orthopteran music that they have detected new species by ear even though careful study was needed to corroborate their opinions as to the taxonomic distinctness by discovering other characters. In this genus, the male (Plate XIX) seems to have gone largely to music—he has broad front wings but a relatively small body. The female, whose wings are wrapped closely to her body, lays her eggs in such stems as those of the raspberry.

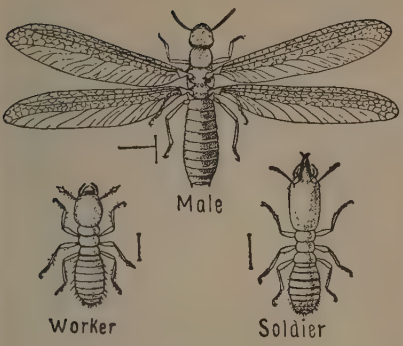
*Xabea*, a related genus, has no spines on the hind tibiæ; first joint of antennæ with a blunt tooth. In *bipunctata* the hind wings are nearly twice as long as the tegmina; the creature is pinkish, the female having two black spots on each tegmen (front wing). *Anaxipha* has the second tarsal joint distinct, flattened vertically, and heart-shaped; *exigua* is less than .3 in. long.

### Isoptera

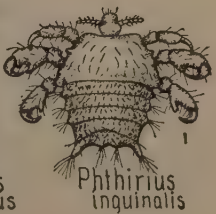
The White Ants are not ants at all but more closely related to the other insects shown on Plate XXI or to roaches. Their greatest development is in the tropics. Our principal species (others occur in the South and West) is *Termes flavipes*. It nests in or under old logs and stumps, more rarely in the decaying wood of houses. Both males and fertile females (queens) have wings which they shed after their marriage flight. The males soon die but the queens live on and become swollen egg-layers. A large part of the offspring are sterile, wingless females, of which there are two kinds: ordinary workers and soldiers.

### Corrodentia

There are two families: Atropidæ, in which the adults have no ocelli and the wings are absent or, at most, a single pair of small ones present; and Psocidæ, in which ocelli




Termes flavipes



are present and wings are well developed. Of the Atropidæ, two species are rather common in old books and on dusty shelves: *Troctes divinatorius* (Plate XXI) and *Atropos pulsatoria*. These creatures are supposed to make a ticking sound, hence the name Death-watch, but this is doubtful. They are also called Book-lice. The Psocidæ may be found in groups on bark, each cluster often being covered with a fine silken net spun from their mouths. Their common name is Bark-lice.

### MALLOPHAGA

Little need be said here about the Bird-lice, except to refer to Plate XXI which shows a common Chicken-louse (*Menopon pallidum*), a Pigeon-louse (*Lipeurus baculus*), and the egg of a louse on the peafowl. Completeness demands a few words about unpleasant creatures, but even these are interesting. Is it not curious that a given species of insect should be confined to the feathers of a single species of bird or the hairs of a certain sort of mammal? This is the case with many Mallophaga. In other cases, the same species of Mallophaga is found on a given kind of bird in the Old World and on a related bird in the New World, indicating that evolution has been less rapid in the parasite than in the host. The winglessness of these insects is undoubtedly a secondary matter—a "degeneration" due to parasitism. Unlike the true lice, they do not suck blood but have biting mouth-parts and feed on hair, feathers, and epidermal scales. Metamorphosis is incomplete. Really these creatures are not bad looking if one views them dispassionately and the egg of at least one of them (see the picture which was redrawn from Bastin's *Insects*) is most striking.

### SIPHUNCULATA

The True Lice have been shifted about somewhat in the scheme of classification. Some put them as an appendix to the Hemiptera. They are small, wingless parasites of mammals, including man. Their eyes are either absent or much reduced; their beak is fleshy and unjointed; their

tarsi are single-jointed, forming a claw at the end of the tibia. Another scientific name for them is Parasita. Three species (Plate XXI) attack man: *Pediculus capitis*, the common Head-louse; *Pediculus vestimenti*, the usually rare Body-louse, Clothes-louse, or Gray-back; and *Phthirius inguinalis*, the Crab-louse which prefers the arm-pits and pubic regions. Liberal and repeated applications of mercurial ointment are "indicated" for the last-named. A fine-toothed comb and keeping the hair greased with vaseline are usually effective in killing off *capitis*. A more suddenly effective remedy is to rub kerosene in the hair at night, wrap the head in a cloth, and wash out the kerosene the next morning; repeat in two or three days. Most of the true lice which attack other animals, such as sheep, hogs, oxen, rabbits, rats, and the like, belong to the genus *Hæmatopinus*.

### THYSANOPTERA

The narrow insects, usually black and rarely more than .04 in. long, which are often seen in flowers, belong to this order; also the Onion-thrips (*Thrips tabaci*) and Thrips in general, some of which are called Black-flies by gardeners. The wings, if any, are very narrow and fringed with long hairs. The feet are bladder-like. The mouth is fitted for sucking but is lop-sided, only the left mandible being developed; the head is held in such a position that the mouth-parts are pressed against the under side of the thorax and concealed. The young are much like the adults but there is a quiescent stage, just before the mature one, which is very pupa-like and during which no food is taken. Some species (both sexes or only one) never or rarely have wings and sometimes males are absent or rare, the eggs developing without fertilization. In these respects they are like aphids, for example. Some species live under bark and in decaying vegetation.

## Hemiptera in General

In the older system of classification "Hemiptera" included insects which are now considered by some good authorities as more conveniently classed in three orders, including Siphunculata (p. 78). They all have sucking mouth parts, if any, and, with certain exceptions, incomplete metamorphosis. The other two orders (or suborders), which have jointed beaks, may be separated as follows:

Each wing of the same texture throughout and usually sloping, roof-like, at the sides of the body; beak arising from the hinder part of the lower side of the head; the head so closely joined to the thorax that the bases of the fore legs touch the sides of the head..... Homoptera.

Each front wing with the base usually more or less thickened, the extremity thinner; wings lying flat on the back, when folded, the membranous tips overlapping; beak arising from the front part of the head; bases of front legs not touching the sides of the head.... Heteroptera or Hemiptera, in the limited sense (p. 95).

## Homoptera

Members of this group differ so much among themselves that several families will probably soon be classed as separate orders. The following key is a modification of the one given by Brues and Melander.

1. **Active,** free-living species; beak plainly arising from the head; tarsi 3-jointed; antennæ very short, with a small, terminal bristle.....2.

**Females** often inactive or incapable of moving; beak appearing to arise between the front legs, sometimes absent in males; tarsi, if present, 1- or 2-jointed; antennæ usually well developed (sometimes absent), without conspicuous terminal bristle.....6.

2. **Our** species, usually, at least .5 in. long; three ocelli on top of the head; antennæ with short basal joint, terminated by a hair-like process which is divided into about 5 joints; front femora thickened and generally spined beneath. Cicadidæ (p. 82).

**Our** species less than .5 in. long; usually not more than
vo ocelli, and front tibiæ not enlarged.....3.
. **Antennæ** arising from below the eyes; ocelli placed
eneath or near the eyes, usually in cavities of the cheeks;
ronotum not unusually developed.....FULGORIDÆ
). 85) in a broad sense.

Antennæ arising from in front of and between the eyes;
ocelli (rarely absent) not usually below the eyes. .....4.
. **Pronotum** extending back over the abdomen.....
MEMBRACIDÆ (p. 84).

**Pronotum** not extending over the base of the abdomen.
5.
. **Tibiæ** smooth, the hind pair with one or two
tout spines and with a cluster of spinules at the
pex.....CERCOPIDÆ (p. 86).
. **Hind** tibiæ with two rows of spines beneath.....
CICADELLIDÆ (p. 86).
eaf-hoppers of which Jassinæ is the principal subfamily.
. **Hind** femora much thickened; antennæ long, 5- to
o-jointed, last joint with two fine apical bristles; front
vings somewhat thicker than the hind, often rather
eathery; pad between the tarsal claws prominent, bilobed.
CHERMIDÆ (p. 86).

**Hind** femora not much larger than the others.....7.
'. **Tarsi** 2-jointed, the basal joint sometimes reduced,
he outer joint with two claws; wings, when present, four
n number; mouth-parts usually well-developed in both
exes.....8.

**Tarsi**, when present, 1-jointed, with a single claw;
emales always wingless, often without legs and usually
overed with a more or less well-developed scale; males
sually with a single pair of wings which lie flat, one above
he other; antennæ of females absent or having up to 11
oints, of males 10- to 25-jointed.....COCCIDÆ (p. 91).
8. **Wings** usually opaque, whitish, clouded or mottled
vith spots or bands; body more or less mealy; tarsi with
2 nearly equal joints; tip of tibiæ with a number of short
spines; a pad-shaped or spine-like process between the
arsal claws.....ALEYRODIDÆ (p. 90).

**Wings** transparent, though sometimes colored; tarsi
2-jointed, the basal joint sometimes very much reduced;

body not mealy, but rarely with waxy wool; process between the tarsal claws absent or nearly so.....
APHIDIDÆ (p. 87).

## CICADIDÆ

These are called Cicadas, Harvest-flies, and Locusts. The eggs are laid in twigs; the newly-hatched young drops to the ground and, burrowing into it, feeds by sucking the juices of roots. It lives in this way for some time (the length depending on the species), its appearance changing but slightly. Finally, it digs out by means of its enlarged front feet, crawls on a tree-trunk or some such thing, splits down the back and liberates the adult. The adult male "sings," often very loudly and shrilly, by vibrating membranes stretched over a pair of sound-chambers situated, one at each side, near the base of the abdomen.

**Tibicina septendecim**

This is the Periodical Cicada or Seventeen-year Locust. As a matter of fact, it is a Thirteen-year Locust in the South. The adult has the same general shape (Plate XXII) as its relatives but its eyes and the principal veins of the wings are red. There is nothing mystical in this color or the W on the wings, although the sudden appearance of the adults in large numbers has been supposed to foretell war. For about sixteen years, in the North, the young suck at the roots of plants. Toward the end of this period scale-like rudiments of wings appear. In the spring of the 17th year the nymph makes its way to the surface of the ground by a smooth firm tunnel. Sometimes, especially if the soil be moist and leaf-covered, it constructs a "chimney" over the exit-hole. Then, from late May to early July, it and the other members of its brood crawl out singly or in droves and, fastening on some support, disclose the adults which have a week or so of aërial life to recompense them for the long period of preparation. There are a score, or more, of different broods, each of which has a rather definite—often restricted—distribution and time of emergence. Suppose there are three such broods in your neighborhood. One of them (that is, the

Tibicina septendecim

A Cicadid nymph

Cicadid egg-scars

Tibicen sayi

Cicada hieroglyphica

adults) may have appeared in 1911; its next appearance would be 1928. Another might be 1916, 1933, and so on; while the third might be 1919, 1936, and so on. As a matter of fact, these are actual broods although they may not be the ones of your neighborhood. However, the example shows that we may have Seventeen-year Cicadas oftener than every seventeen years, to say nothing of the possibility of laggards or extra-spry individuals, in the various broods, which do not appear on schedule time.

There are numerous other species of this family. It might be noted that the name *Cicada tibicen*, of many books, as applied to one (or all!) of our Harvest-flies, is an error, *Cicada tibicen* probably being a tropical species. The differentiation of species is based largely on the form of the male genital plates, although there are size- and color-differences and an attentive ear can detect differences in song. Of the genus *Cicada* (as now limited, = *Tettigia*), the small *hieroglyphica* (Plate XXII), with an almost transparent abdomen, may be found in pine barrens, and is our only species. Plate XXII also shows a common species of *Tibicen* which is fairly typical of its genus, the common one in our region. The somewhat similar *Okanagana* is more common in the West than with us.

### Membracidæ

The Tree-hoppers have been aptly called Insect Brownies. If you doubt the aptness see Plate XXIII or, better, look at a number of species, full in the face, through a low-power lens. The prothorax is variously modified and, in some of the tropical species, the modifications are very extraordinary. The young differ from the adults in being more normally shaped. Many of these young and some of the adults excrete "honey-dew," much as aphids do, and are eagerly attended by ants for the sake of this fluid. All of the species suck plant juices and the eggs are usually laid in the tissues of the food-plants. They are called Tree-hoppers because most of the species live on trees and low bushes, hopping vigorously when disturbed. They are best collected by beating them into an upturned

umbrella but the collector must act quickly or they will hop out again.

A synopsis of the genera, by Goding, is given in *Transactions of the American Entomological Society*, vol. xix. Plate XXIII shows a few of the many species. *Ceresa bubalus*, the Buffalo Tree-hopper, is often injurious to young orchard trees, especially apple, by reason of the scars made in the bark when the females lay their eggs. If a simple slit were made, it would not be so bad but there are two slits at each place, crossing beneath the bark and so killing the intervening part. Most of the young leave the trees to feed on nearby weeds.

### Fulgoridæ

The prothorax of the Membracids is over-developed but the Fulgorids have gone to head. *Fulgora lanternaria* (Plate XXIII), of the American tropics, is an extreme type and one of the insects which is commonly sent to the Museum as a great rarity. It is shown here partly because it illustrates the truth that weird-looking things are not always rare; and also because it and some of its relatives have given the common name of Lantern-flies to the family. There are circumstantial stories concerning the luminosity of Fulgorid heads and categorical denials of these stories. The Noes probably have it but, at any rate, the name sticks. Plate XXIII shows also *Scolops sulcipes*, which is fairly common in our region on grass and other plants, especially where the ground is somewhat moist. Other species, such as *Acanalonia bivittata* (Plate XXIII; pink specimens are not uncommon), have a more normal head and frequently look like small moths. Such species are often covered with an easily rubbed "meal" and, in the tropics, there are species which bear so many and such large filaments of a waxy substance that other insects live in the excretion. The eggs, as far as I know, are laid in plant-tissue but although there are many species even in our region—more south of us—they have not been well studied. Later authors split the family into a number of separate families or subfamilies.

### Cercopidæ

The Frog-hoppers or Spittle-insects get their common names by being broad, squat, hopping creatures whose young live in masses of white froth (Plate XXIII), sucking sap. "The spittle is a viscid fluid expelled from the alimentary canal of the insects and beaten up into a froth by the whisking about of the body. What advantage it is to the young insects is hard even to conjecture; it certainly is not known" (Kellogg). Possibly it is a protection against drying out and it is said to harden into a protective shell when the insect molts.

### Cicadellidæ

These are the Leaf-hoppers. In the South, the species which attack cotton have been named Sharpshooters and Dodgers. All of our numerous species are small and occur on vegetation of various kinds, especially grasses. Doubtless the small amount of sap taken by each of thousands of individuals amounts to a great deal per acre of grassland, vineyard, and orchard. Plate XXIII shows *Graphocephala coccinea*. This family has been called Jassidæ.

### Chermidæ

The Jumping Plant-lice are usually described as resembling miniature Cicadas. The antennæ are long and the wings are transparent. Some of the species, especially of the genus *Pachypsylla*, produce galls, while others feed in exposed situations on the leaves. Probably the most injurious species is the Pear Psylla, *Psylla pyricola*. It was introduced from Europe about 1832. "Usually the first indication of the pest is the presence of large quantities of honey-dew, secreted by the nymphs, with which the foliage becomes covered, and which attracts numerous ants. When the psyllas are numerous the leaves and fruit become coated with this sticky substance and it even drops from them like rain and runs down the trunk. ["Weeping trees" are caused by a number of different Homoptera.] A blackish fungus grows on the honey-dew and is always a

Fulgora
Scolops sulcipes
A young Cercopid in its "spittle"
Acanalonia bivittata
Graphocephala coccinea
Egg scars of Ceresa bubalus
Ceresa bubalus
Archasia belfragei
Thelia bimaculata
Entylia sinuata
Telamona ampelopsidis

good indication of the presence of the psylla. . . . The adult is about one-tenth inch long, of a reddish crimson color with brownish-black markings, bronzy eyes and dark wing-veins. . . . The egg is about one-eighteenth inch long, hardly perceptible without a lens, and orange-yellow in color. It is pear-shaped with the small end drawn out into a long thread" (Sanderson).

### APHIDIDÆ

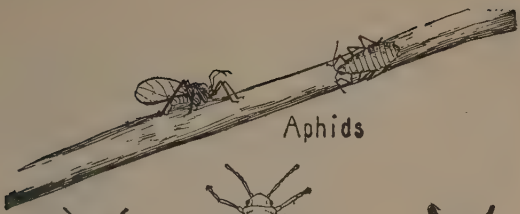
In his memoir on insects affecting park and woodland trees Dr. Felt has a section which he entitles "The Battle of the Weak or Interesting Facts about Aphids." The title is striking and true. These creatures (Plate XXIV) are called Plant-lice, Green Flies, Blight (from the damage they do) and other things also. They are among the most injurious, the most interesting, and the most puzzling of insects. It would be difficult to improve on some of the many general accounts of their life cycle; as Dr. Felt has just been mentioned, his summary may be quoted: "Many of the species pass the winter in what we know as the winter egg, which is usually deposited in crevices of the bark or at the base of buds or branches, where it remains during the winter. The young hatch therefrom in some cases at least at about the time the foliage begins to develop and in other instances not till well toward mid-summer, establish themselves at some favorable situation and begin to draw nourishment from the unfolding tissues. These young are all females and in the language of science are known as 'stem mothers.' They usually begin to produce young in a few days after hatching from the egg and these are also females and in turn produce others. This method of reproduction is what is known as agamic or asexual and differs from the ordinary in that males have no part in the process. A number of generations may be produced in this way, the adults being wingless, and after a time, usually at the end of a certain number of generations, winged females develop. These latter forsake the original, usually by this time crowded, food-plant and either fly to similar ones in the neighborhood or, as in the case of some species, betake themselves to entirely different

plants, where another series of wingless agamic or asexual generations are brought forth. This may continue for some time and after a certain number of generations the plants again become crowded, winged females are produced and there may be a return migration to the original food plant, where one or more generations may be produced and ultimately perfect males and females, which latter pair and deposit eggs in crevices of the bark or other shelters, as stated above, and remain unhatched over winter."

This changing from one mode of reproduction to another and from one food plant to another, together with still other complications, is very confusing. Lichtenstein has noted twenty-one different forms assumed by *Phylloxera quercus* in its life-cycle. It is probable that the four hundred or so forms which have been described from the United States as distinct species include phases of a smaller number of real species, but it is certain that many species are still undescribed.

A common species on apple is *Aphis mali.* Professor Webster said concerning it: "It would appear almost visionary to advocate spraying apple orchards in midwinter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twig of the apple during the winter season." The Woolly Apple-aphis, *Schizoneura lanigera* (Plate XXIV), secretes a waxy substance, which accounts for its name. It is often seen on twigs and around wounds, clustered in bluish-white masses that look like mold, but the individuals which are probably doing the most damage are feeding upon the roots where they cause gall-like swellings. *Phylloxera vastatrix* is one of the few American insects which have become injurious in Europe. With us it forms galls on grape leaves (see p. 470) but is not usually found on the roots; in Europe it rarely attacks the leaves but forms galls on the roots, causing them to decay.

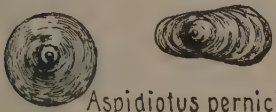
Aphids excrete a sweetish substance, called honey-dew, which is much sought after by ants. In fact, aphids are called "ants' cows" and many species of ants go to considerable trouble to care for them. A variety of *Lasius*


Aphids

Schizoneura
lanigera

Aleyrodes
vaporarium

Underside
of a
Coccid

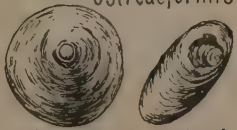

Aspidiotus perniciosus

An adult
Male Coccid

Lepidosaphes ulmi
Chionaspis
furfura

Aspidiotus
ostreaeformis

Aspidiotus ancylus


Aspidiotus forbesi

*niger* is an ant which attends to the Corn-root Aphis, *Aphis maidi-radicis*. During the winter this ant stores the small black eggs of the aphis in its nests, moving them from place to place as the weather changes. The eggs start to hatch in early spring and the ants uncover the roots of smart weed and of other plants in order to pasture their cows. When, however, corn is planted, they transfer the aphid stock to the corn roots, including such winged aphids as may have developed and strayed from the fold.

A female aphis does not lay many eggs as compared with insects in general, but development is so rapid (ten days is not unusual, the eggs frequently hatching before they are laid so that birth is given to living young) and there are so many generations a season that the end result would be extermination of all life by the destruction of vegetation *if* it were not for counteracting agencies. Some aphids are protected by ants, some by waxy secretions, some by foldings and galls produced in leaves and other parts of plants by their presence, but all are injured by damp weather, by fungi and by insect enemies. Among the latter might be mentioned Coccinelidæ, Syrphidæ, and Chrysopidæ, which, together with less important enemies, devour them from the outside. But we should not overlook the Chalcididæ, which feed internally. Look at the aphid colonies on a rose bush and you are almost certain to see the dried shells of individuals which have been parasitized by these, our friends, a small hole in each showing where the Hymenopteron had emerged.

### Aleyrodidæ

This is the White-fly family. *Aleyrodes vaporarium* (Plate XXIV) is the species most often found on house-plants. The adults of both sexes have four wings and seem to be covered with flour; their wing expanse is usually less than an eighth of an inch. The young somewhat resemble scale-insects. As seen through a lens, they are rather pretty, usually shiny black with white, wax-like rods and tufts. Each egg is mounted on a small, curved stem. Probably the majority of the American species are still undescribed; they rarely appeal to amateurs and, for the most part, they are of little economic importance.

## Coccidæ

"The family includes a number of quite different-looking insects, as the True Scale-insects or Bark-lice, the Mealy-bugs, and others for which we not even have a popular name. They are a very anomalous family, and the species differ very greatly in appearance, habits, and metamorphoses from the other allied families already described. Even the sexes of the same species differ as much in the adult stage as do the members of different orders. The males, unlike all other Hemiptera, undergo a complete metamorphosis, but possess only a single pair of wings. The hind wings are simply represented by a pair of club-like halteres, as is the case in the Diptera or Two-winged Flies. Each of these halteres is furnished with a hooked bristle, which fits in a pocket on the upper wing on the same side. The males possess no mouth. . . . The female is always without wings and has either a scale-like or a gall-like form, and is covered with larger or smaller scales of wax, which may be in the form of powder, of large tufts or plates, of a continuous layer, or of a thin scale. Beneath this protecting substance lives the insect. . . . All scale-insects are plant-feeders, and like the plant-lice obtain liquid food by means of suction. But not all are injurious, as some furnish dye-stuffs, shellac, or wax" (Lugger).

All scale-insects are injurious to the plants upon which they feed, but what Prof. Lugger meant was that, as far as man is concerned, the harm which certain species do is more than counterbalanced by the benefits we derive from them. The manna which fed the Children of Israel was honey-dew secreted by a scale-insect. It is still eaten. Shellac is derived from the scale of *Carteria lacca* in India and the insect itself contains a red substance called "lake." Before the present extensive use of aniline dyes, coloring matter was derived from a number of different species of Coccidæ, especially from the Cochineal Insect, *Coccus cacti*, of Mexico. The natives of the island of St. Vincent make necklaces from the encysted pupæ of *Margarodes*, calling them "ground-pearls."

Coccidæ sometimes produce living young and reproduce without sexual union, but these phenomena are not so general as among the Aphididæ. A single female Coccid may give birth to thousands of young, but these do not reach maturity as quickly as do the plant-lice. The males of many species of scale-insects are unknown, probably because their small size and short life have caused them to be overlooked, rather than because they are rare or absent.

Three of the subfamilies are of especial economic importance to us; they are the Dactylopinæ or Mealy Bugs, the Coccinæ or Soft Scales, and the Diaspinæ or Armored Scales.

### Dactylopinæ

The female Mealy Bug undergoes but little change of form as it matures and it is able to move about. No real scale is formed, at most a sort of cottony sac, and this usually only when the insect is nearly full-grown.

A common species in greenhouses is *Pseudococcus citri*. The oval body is bordered by a white fringe and covered with a mealy deposit. The eggs are laid under the female in a loose nest of sticky, white fibers in such quantities that she is forced to stand on her head in order to feed.

*Phenacoccus acericola* frequently occurs in great numbers on maple leaves. The female is light yellow but covered with a mass of powdery, slightly stringy, white wax about three times her own bulk.

Various species of *Kermes* occur on oak. The adult females are relatively large and look like galls.

### Coccinæ

The Soft Scales are usually of considerable size as compared with other scale-insects; their surface is rather waxy and their form more or less convex. Such "scale" as they have is merely the thickened surface of the insect itself and not a separate structure.

Females of *Pulvinaria* secrete a mass of cottony material in which they place their eggs. *P. innumerabilis* is the

common Cottony Scale of maple, and, to a lesser extent, of elm, grape, Virginia Creeper, and other plants. When common, the ground or pavement beneath them becomes covered with a black, sticky substance, the honey-dew, upon which a peculiar fungus grows.

*Eulecanium* is a large genus, some members of which are likely to be found in every yard that contains fruit. The females lay their eggs under their bodies but do not secrete a cottony covering. *E. nigrofasciatum* is the Terrapin Scale of the peach and other trees. *E. pruinosum* is the Frosted Scale of fruit and forest trees. Tulip trees should be examined for *E. tulipiferæ;* it is one of the largest Soft Scales of our region.

Several species of *Saissetia* are frequently found on palms, ferns, and other house-plants.

## Diaspinæ

These are *the* scale-insects. Their body is covered by a shell, which is composed in part of moulted skins and in part of a secretion from the body itself.

**Aspidiotus perniciosus**

With good reason, this (Plate XXIV) is the scale most often inquired about. It is the Pernicious or San José, and is so small (about .06 in. long at most) that it is not usually noticed until it has become destructively abundant. Felt says: "Trees which have been badly infested for some time have a rough bark covered with dark gray, scurfy patches, and, if this be scratched with a knife or finger nail, an oily yellowish substance will be crushed from the living insects under the scales. This insect breeds so rapidly that it is not uncommon to find large numbers on a tree previously comparatively free. In that event the bark may be literally covered with recently established scales and not appear very rough. There is, however, a peculiar, granular look, and those familiar with the bark of a rapidly growing tree are aware that some change has taken place. There is nothing like a good magnifier in these cases, and, if this shows hundreds of circular, black or dark gray objects, with dot and ring, or lighter gray, yellowish marked scales, send a sample of the bark to somebody

competent to identify the trouble. Cutting into the bark under a San José scale is almost sure to reveal a reddish discoloration of the green tissues beneath. . . . The winter is passed by this insect in a partly grown, dormant condition. Vital activities are resumed with the approach of warm weather, and the first outward indications of life are seen in the appearance of winged males and later of the crawling young, the latter of which appear in this latitude [New York] toward the last of June. . . . The females continue to produce young for a period of about six weeks, each averaging about 400, or from nine to 10 every 24 hours. This is an ovo-viviparous species. That is, the eggs develop within the mother and the young are born alive. They may be seen as tiny yellow specks escaping from under the maternal scale, from which they wander in search of a favorable place to establish themselves. . . . The development of the scale begins, even before the young has selected its feeding place, as very minute, white, waxy filaments, which spring from all parts of the body, rapidly become thicker, and slowly mat down to form the circular white scale with a depressed ring and central elevation. . . . Thus the round of life may be completed, as determined from a study of the female, in from 33 to 40 days. The detailed studies made at Washington show that four full generations are developed normally in that latitude and that there may be a partial fifth." The fact that this insect lives on a great variety of woody plants makes eradication difficult; we must spray more than the few trees we care about. If you have it, notify your State Entomologist and do not trust to Jim Jones around the corner, who says he can kill it for you. It is a native of eastern Asia; San José, California, is connected with it merely because the specimens upon which the first scientific description was based came from there.

*Lepidosaphes ulmi*, called *Mytilaspis pomorum* in many publications, is the Oyster-shell Scale. It infests a variety of trees, including apple, and is well described by its common name, although the oyster-shell shape is not entirely diagnostic. The small end of the tapering, slightly curved scale is usually yellowish. See Plate XXIV for it and other species.

## HETEROPTERA

### Or True Hemiptera

For the general characteristics of the True Bugs see p.80. In the following key rare families have been omitted; see Brues and Melander, or Parshley in *Psyche*, Vol. XXII. Nymphs may usually be distinguished from wingless adults (such as occur in certain families) by the fact that most nymphs have two pairs of pimple-like stink-glands near the middle of the back of the abdomen. When the basal part ("corium") of the front wings is thickened, the apical unthickened part is called the "membrane"; the triangular area, when present, at the tip of the corium is called the "cuneus."

1. **Antennæ** shorter than the head and usually nearly or quite concealed; living in or near water.....2.

**Antennæ** longer than the head (if sightly shorter, the eyes and ocelli are absent), usually free, rarely (Phymatidæ) lying in a groove.....8.

2. **Ocelli** present; littoral; not .5 in. long.....3.

**Ocelli** absent; aquatic.....4.

3. **Antennæ** hidden; front legs stout, formed for grasping; broad, squat, roughened bugs with prominent eyes. Gelastocoridæ, also called Galgulidæ and Nethridæ. These predaceous Toad-bugs frequent muddy banks. *Gelastocoris* (=*Galgulus*) is our principal genus (Plate XXV); the front tarsi have 2 claws. *Mononyx* of the West and *Nerthra* of the South-east have but 1 claw on these.

**Antennæ** not hidden; front legs slender, as long as middle ones, formed for running. Ochteridæ. Resembles the preceding in form and habits. *Ochterus* is our only genus.

4. **Hind** tarsi without distinct claws (except *Plea*, p. 102); front legs not specially formed for grasping.....5.

**Each** hind tarsus with 2 claws; front legs formed for grasping.....6.

5. **Body** flat above; top of head free from pronotum; front tarsi flattened, 1-jointed, without claws, edges fringed; beak with not more than 2 joints, hidden .....CORIXIDÆ (p. 99).

**Body** convex above and pronotum overlapping the head; front tarsi normal, 2-clawed; beak 3- or 4-jointed .....NOTONECTIDÆ (p. 100).

6. **Membrane** with veins.....7.

**Membrane** without veins. NAUCORIDÆ. They resemble Gelastocoridæ (3) but do not have prominent eyes, and crawl about on submerged plants. *Pelocoris* is our only genus. *P. femoratus* is about .4 in. long; pronotum shiny yellow or light brown, marked with numerous dark spots; front wings dark brown with a light shoulder-area. *Ambrysus* occurs in the West.

7. **Apical** appendages of abdomen long and slender, not retractile; hind legs formed for walking...NEPIDÆ (p. 100).

**Such** appendages short, flat, and retractile; hind legs flattened for swimming.....BELOSTOMIDÆ (p. 99).

8. **Head** shorter than thorax, including scutellum.....9.

**Head** as long as entire thorax; body and legs slender.....HYDROMETRIDÆ (p. 104).

9. **Last** tarsal joint divided, claws back of tip; front wings, if present, of rather uniform texture throughout..10.

**Last** tarsal joint not divided, claws at tip.....11.

10. **Middle** and hind legs very long, close together and distant from the front pair; beak 4-jointed but the first joint short.....GERRIDÆ (p. 103).

**Middle** and hind legs not very long, more equally spaced; beak 3-jointed.....VELIIDÆ (p. 103).

11. **Antennæ** 5-jointed.....12.

**Antennæ** 4-jointed (Do not count either the tubercle which bears the antennæ or the minute intermediate segments which are sometimes present).....13.

12. **First** and second antennal segments thicker than the others; minute bugs living on surface of water. HEBRIDÆ. *Hebrus*, our only genus.

**First** antennal segment thick, second slender; scutellum rather large.....27.

13. **Prosternum** with a median, longitudinal, striated or granulated, stridulatory groove visible in front of front

coxæ, receiving the tip of the beak, which is 3-jointed, short, and strong; length not less than .2 in.....14.

**Prosternum** without a stridulatory groove; size large or small.....16.

14. **Body** very long and slender, almost thread-like .....EMESIDÆ (p. 108).

**Body** not so.....15.

15. **Terminal** segment of antennæ thickened, front legs stout and much modified for grasping; membrane with numerous veins; tarsi 2-jointed.....PHYMATIDÆ (p. 110).

**Terminal** segment of antennæ thread-like; front legs usually much like the others; membrane with few veins; tarsi 3-jointed.....REDUVIIDÆ (p. 107).

16. **Front** wings wholly membranous and, for the most part, with a dense network, sometimes resembling lace; cheeks raised, forming a groove which includes the base of the beak; tarsi 2-jointed; flat bugs of small size.....TINGIDIDÆ (p. 110).

**Not** such insects.....17.

17. **Beak** really or apparently 3-jointed.....18.

**Beak** 4-jointed; first segment sometimes short.....22.

18. **Body** convex below, flat or slightly concave above; often wingless; small, aquatic, predatory bugs, usually found on floating vegetation. MESOVELIIDÆ. *Mesovelia mulsanti*, our only species.

**Not** such insects.....19.

19. **Tarsi** 2-jointed; broad, flat bugs, living under bark; head produced between antennæ; abdomen broader than the closed wings.....ARADIDÆ (p. 112).

**Tarsi** 3-jointed.....20.

20. **Ocelli** present.....21.

**Ocelli** and wings usually absent or rudimentary; parasitic on vertebrates.....CIMICIDÆ (p. 106).

21. **Front** wings with a cuneus, membrane without long closed cells, sometimes without veins; small, predatory bugs.....ANTHOCORIDÆ.

**Front** wings without a cuneus, membrane with 4 or 5 long closed cells; adults always fully winged; small flattened bugs with large, projecting eyes..SALDIDÆ (p. 102).

22. **Ocelli** absent.....23.

**Ocelli** present.....24.

**23. Membrane** with two large cells at base from which extend about 8 branching veins; no cuneus; rather large, strong bugs.....PYRRHOCORIDÆ (p. 110).

**Membrane** with one or two small cells at base, rarely with longitudinal veins; distinct cuneus; first joint of beak rarely shorter than the head.....MIRIDÆ (p. 105).

**24. Front** legs modified for grasping, the tibiæ and usually the femora armed with rows of numerous, closely set, fine spines; first joint of beak very small. NABIDÆ, the Damsel-bugs. They are usually yellowish or black, rather flattened, predaceous, and found on flowers or leaves. *Nabis* (=*Reduviolus* and *Coriscus*) is our principal genus.

**Front** legs usually much like the others; first segment of beak usually longer than wide.....25.

**25. Body** very slender; antennæ elbowed, the first joint long and clubbed, the last joint spindle-shaped; head constricted in front of the eyes; femora clubbed .....NEIDIDÆ (p. 112).

**Not** such insects.....26.

**26. Antennæ** usually inserted on or below a line drawn from the eye to the base of the beak; membrane usually with 5, simple veins.....LYGÆIDÆ (p. 111).

**Antennæ** starting from well up on the sides of the head; membrane usually with numerous, forked veins arising from a transverse basal vein (these veins sometimes hard to see).....COREIDÆ (p. 113).

**27. Scutellum** nearly flat, narrowed behind.....28.

**Scutellum** very convex, covering nearly the whole abdomen.....29.

**28. Tibiæ** usually with no (or very fine, short) spines .....PENTATOMIDÆ (p. 113).

**Tibiæ** with rows of strong spines. CYDNIDÆ. Sometimes classed as a subfamily of Pentatomidæ.

**29. Pronotum** round in front and nearly straight behind; margins of scutellum with furrows in which the edges of the wings fit when at rest; tibiæ strongly spinose. Subfamily Thyreocorinæ of Cydnidæ; has also been called CORIMELÆNIDÆ.

**Pronotum** hexagonal; margins of scutellum without furrows; tibiæ not strongly spinose. SCUTELLERIDÆ.

These are sometimes classed as a subfamily of Pentatomidæ. Some species are large and brightly colored but they are not usually common.

### Corixidæ

The Water-boatmen (most boatmen are that kind) swim "right side up." Compare Notonectidæ. They are slightly heavier than water and rest on the bottom or on aquatic plants, but when they come up for air, the surface tension is sufficient to hold them at the top without much effort on their part. At such times, they float in a horizontal position, taking air directly into the thoracic spiracles and renewing the supply of air which is carried by hairs when they dive. It is said that these insects, while submerged, but especially at night, make a tolerably loud and sustained noise by rubbing their beak with their front legs. The eggs are usually fastened on, not in, submerged objects; the eggs of certain specie in the lakes near the City of Mexico are so abundant that they are gathered by the Mexicans and used for food. This family is predaceous and its members, like their relatives, are attracted, in their nocturnal flights, by light. The principal genus in our region is *Arctocorixa—Corixa* of most publications (Plate XXV).

### Belostomidæ

This family contains the Giant Water-bugs; also called Electric-light Bugs because the adults are frequently noticed flying about electric lights. Some of the tropical species are the largest of Hemiptera, being four and five inches long. The broad, flat hind legs and the flat body, with a keel in the middle underneath, well fit them for aquatic locomotion. The sharp-hooked front legs and the short, powerful beak make their predatory habits not to be depised by even fair-sized fish. They lurk on muddy bottoms, often slightly covering themselves with mud or leaves, ready to dart out after the unwary. Before mentioning one of the interesting habits of some of them we must, unfortunately, note a change in names: the generic name, *Belostoma*, which has been used in most publications, should be *Lethocerus*, and *Zaitha* becomes *Belostoma*.

In this sense, the females of *Belostoma*, and of certain other genera, fasten their eggs onto the backs of the males. It is said that the males do not take kindly to this procedure but that they can not help themselves.

1. **Hind** tibiæ much broader than middle ones; front coxæ little longer than broad. . . . . 2.

**Hind** tibiæ little, if any, broader than middle ones; front coxæ at least twice as long as broad. All of our species are less than 1 in. long. . . . . *Belostoma*.

2. **Margins** of front femora with a longitudinal groove in which the tibiæ lie when folded. *Lethocerus*, of which *americanus* is our common species; it is about 2 in. long.

**Margin** of front femora without such groove. *Benacus griseus* (Plate XXV).

### Nepidæ

The long respiratory tail of Water-scorpions is not fully developed until the molt which gives them wings. It is perfectly harmless; all the sting these creatures have is at the other end, their beak. We have two genera, both of which are aquatic and predaceous: the body of *Nepa* is oval, flat, and thin; that of *Ranatra* (Plate XXV) is linear and cylindrical. They are sluggish creatures, crawling but not swimming, often remaining motionless for hours on the muddy, leaf-covered bottom of their favorite haunts and rarely, if at all, coming to lights. Their eggs, which are placed in or on submerged objects, are furnished with filaments at one end, seven in *Nepa* and two in *Ranatra*. The only species of *Nepa* is *apiculata*, which is about .75 in. long, not counting filaments. *R. americana*, about 1.25 in. long, is our most common species of *Ranatra* in the East.

### Notonectidæ

The Back-swimmers are shaped somewhat like an overturned boat, but they overturn themselves when they are in the water. They are lighter than water and normally rest at the surface, floating head-down, with the tip of the abdomen piercing the surface-film, their long hind legs extended like sweeps ready to send them swiftly to safety

Arctocorixa interrupta

Benacus griseus

Gelastocoris oculatus

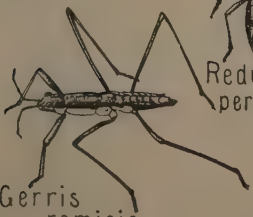
Lygus pratensis

Ranatra americana

Notonecta undulata

Pœcilocapsus lineatus

Reduvius personatus



Gerris remigis

Arilus cristatus

or food. They do not breathe through their tail but from it the air passes through hair-covered channels to spiracles on their thorax. Small fish and other aquatic animals are easy prey, and the suctorial beak will pierce even the careless collector's fingers. Doubtless the pearly color of their backs, which, as they swim, is seen against the sky, and the dark of their under (upper) side helps them to approach their victims and to avoid becoming victims. The adults fly well and are frequently attracted to lights. During the winter they sometimes may be seen swimming about in the shallow water in which they habitually live, even though it be covered with ice. It is said that these insects, by rubbing their front legs together, make a noise like the word "chew," twice repeated. The eggs are placed in the submerged stems of aquatic plants. The adults of *Plea striola* are only about .06 in. long; it is the only species of that genus. Our other species are much larger and, for the most part, belong in *Notonecta* (Plate XXV).

### Saldidæ

This family has been called Acanthiidæ, but a technicality rules out the use of that name. Furthermore, its use would be confusing, as the Saldidæ have no intimate connections with bed-bugs but live on the shores of lakes and rivers. Uhler, one of the master Hemipterists, wrote: "In the present family we have types which like *Galgulus* [*Gelastocoris*], make holes for themselves, and live for a part of the time beneath the ground. Like the members of that genus too, a majority of them inhabit damp soils, and are often found in countless numbers on the salt or brackish marshes of our sea coasts. Their manner strongly recalls that of the tiger-beetles that inhabit the same places. When approached, or in any way disturbed, they leap from the ground, arise a few feet into the air, by means of their wings, and alight a short distance away, taking care to slip quickly into the shade of some protecting tuft of grass or clod, where the soil agrees with the color of their bodies." They feed chiefly upon the juices of drowned insects. There are numerous species of *Saldula*, the principal genus of our region. They are rather soft in

texture, with small head and prominent eyes. Their size is never large and their color is black, sometimes marked with white or yellow.

### Veliidæ

These have been called Broad-shouldered Water-striders (see Gerridæ). *Rhagovelia obesa* is very common in some localities, preferring swift streams. It is black, about an eighth of an inch long, and usually wingless. *Rhagovelia plumbea* lives on the Gulf of Mexico, near the shores. Members of this family are more given to going *into* the water than are their relatives and they may sometimes be seen running, back downwards, on the under side of the surface film.

### Gerridæ

The family name of this group of Water-striders or Pond-skaters has usually been given as Hydrobatidæ. Unfortunately there have been considerable changes in the taxonomy of Hemiptera, as you will notice, and no agreement has yet been reached. One system is to make the Veliidæ, Mesoveliidæ, and Hydrometridæ subfamilies of Gerridæ. Of Gerridæ, in the narrow sense, and now put in the genus *Gerris*, one common species (*marginatus*) has often been listed in the genus *Limnotrechus*, and another (*remigis*, Plate XXV), in *Hygrotrechus*. These two species and their less common relatives may be seen skating about on the surface of ponds or of the less rapid parts of streams, often jumping up and landing again without breaking the surface film. They go about on the two hinder pairs of legs, pushing with the middle pair, steering with the last, and holding the front pair up so as to be ready to grasp their food, which consists of either living or dead insects and the like. Why are they able to run on the surface of water? Because their hairy legs are not wetted and so, with the slight pressure of the insect's little weight, they dimple but do not break the surface film. A greased needle will float for the same reason. Both winged and wingless adults of the same species occur. Eggs are laid at or just beneath the surface of the water on almost any solid object. Adults

occasionally go under water; they hibernate and sometimes come out in warm winter days to stretch their legs. If you desire to bring home alive for your aquarium species of this and related families, use for the purpose a dry box or one in which there is some damp moss; they frequently drown if carried in a pail containing water. The following key includes the genera most often noticed in our territory.

1. **Body** oval, less than 3 times as long as broad; pronotum not longer than broad.....2.

**Body** elongate, more than 4 times as long as broad; pronotum much longer than broad. *Gerris*.....3.

2. **Second** segment of antennæ longer than either third or fourth segment.....*Metrobates hesperius*.

**Second** segment of antennæ shorter than either third or fourth segment.....*Trepobates pictus*.

3. **Antennæ** longer than head and pronotum together; hind tibiæ and tarsi, together, much longer than middle tibiæ. Subgenus *Limnoporus*, species *rufoscutellatus*.

**Antennæ** shorter than head and pronotum together; hind tibiæ and tarsi, together, but little longer than middle tibiæ.....4.

4. **First** segment of antennæ nearly the same length as fourth. Subgenus *Gerris*, of which *marginatus* is a common species.

**First** segment of antennæ considerably longer than fourth. Subgenus *Aquarius*, of which *remigis* is our common species.

### Hydrometridæ

This family has also been called Limnobatidæ and the type, as well as our only, genus is then called *Limnobates* instead of *Hydrometra* (see also Gerridæ). The common name is Marsh-treaders. *Hydrometra martini* (also called *lineata*) is not rare but is not often seen. It is not quite .5 in. long, very thin, and walks very deliberately over the water and projecting plants. Quoting Uhler again, "They delight to remain at rest, with perhaps a single claw hooked to some projecting object. When disturbed they move very slowly, and seem disposed to save themselves

rather by concealment among rubbish and tangled growths than by active movements. The young forms are so very slender that they can only be detected with great difficulty in the places to which they resort."

### Miridæ

These are what have generally been called Capsidæ. It is one of the largest families of true bugs and a very bewildering one to the students who would attempt to classify the species. Most of them are leaf-feeders but some are predaceous. The eggs of many, at least, have two filaments at one end, which project from the plant-stems in which they are laid.

**Lygus pratensis**

The ground-color of the very common Tarnished Plant-bug (Plate XXV), ranges from dull brown to yellowish-brown, and its markings are also variable. Typically, the head is yellowish with three narrow-reddish stripes and the following markings are yellowish: margin of pronotum, several longitudinal lines on it, a V on the scutellum, the legs, and a spot at the apex of the thickened part of each front wing. This insect is very destructive of a large range of vegetation from strawberries to fruit-trees. Adults hibernate in rubbish and appear in early spring. The punctures, made for the purpose of sucking juices, seem to have a poisonous effect on buds and leaves. Probably the eggs are laid in plant-tissues.

**Pœcilocapsus lineatus**

The Four-lined Leaf-bug (Plate XXV) is dark green (yellow after death), with the head, forepart of the pronotum, and underside of body, orange-red. There are four, more or less continuous, black, longitudinal lines on the pronotum and front wings. While particularly injurious to currants and the like, it attacks many different plants. "The presence of the pest is indicated by the appearance of the peculiar brown depressed spots on the tender terminal leaves in early summer. As the attack continues, whole leaves turn brown, curl up, become brittle, and are torn

or broken by the wind. The young shoot is checked and frequently droops and dies. The buds of dahlias and roses are often blasted." The vermilion nymphs hatch from overwintered eggs placed in slits, cut lengthwise into the stems of the plants, each containing six or more eggs. The adult stage is reached about the middle of June.

*Halticus uhleri* is one of the smallest species of the family; black with yellow on legs, antennæ, and, as scale-like tufts, on the front wings. They hop like flea-beetles and feed on a variety of garden-plants. Some individuals are short-winged.

Some Mirids slightly resemble ants in shape and have yellow spots so placed as to increase the resemblance by giving them the appearance of having narrow waists, but it is difficult to prove that this resemblance is of any use to them.

### Cimicidæ

Most of us have had experience with one member of this family, although many do not like to talk about it. Perhaps no other insect has been given so many euphemistic names, but the one which is most generally understood is plain Bed-bug. In fact, that is a translation of (or, is it the other way around?) its scientific name, *lectularius*. It belongs to the genus *Cimex*, which has also, improperly, been called *Acanthus*. A description of its appearance and smell is unnecessary, especially in a Field Book; it is *never* found afield, under bark and the like; those are quite different creatures. It is also confused with the creature which closely resembles it and is often found in the nests of swallows; that is *Œciacus vicarius* (=*hirundinis*) and rarely bothers man. The number of generations a year of *lectularis* depends on the temperature and food-supply; there are, normally, only one or two and it is not true that "they become grand-fathers in a night." Kerosene in all the bed-room cracks and crannies will do the trick but, especially in the spring, the treatment should be repeated in order to kill those which were unhatched at the time of the first application and may have been protected by the egg-shell.

## Reduviidæ

Some of the Assassin-bugs are rather striking creatures; nearly all are fairly large and some are gayly colored. They are predaceous, feeding chiefly on the juices of other insects.

**Reduvius personatus**

As the "Kissing Bug" this creature (Plate XXV) received considerable newspaper space some years ago. Another, and better, common name is Masked Bed-bug Hunter. It often enters houses where it and its young feed on bed-bugs. Especially the young have many sticky hairs to which dust and other small particles adhere, making the mask. Many Reduviids have these sticky hairs and should not be put in a collecting bottle together with delicate insects. If *personatus* bites humans, as it rarely does, a very painful wound is caused, so that the newspaper stories have some basis in fact.

A southern species of similar habits, but much more given to sucking human blood, is *Triatoma* (= *Conorhinus*) *sanguisuga*. In the South, it is called the Big Bed-bug. It is about an inch long; black, marked with red on the sides of the prothorax, at the base of the apex of the front wings, and at the sides of the abdomen; the head is long, narrow, cylindrical, and thickest behind the eyes. It is said that the effect of its bite may last for nearly a year, and it is probable that attacks which are attributed to spiders are really the work of this insect. Out-of-doors, it feeds on insects, including grasshoppers and potato beetles.

Another species which has been accused of being a kissing-bug is *Melanolestes picipes*. It is black; about .6 in. long; the head well drawn out in front of the eyes, behind which is a tranverse, impressed line; the prothorax is more or less bell-shaped and divided into two lobes; the legs are short, the femora stout, and each tibia has a large pad at its apex. In nature it is often found hiding under stones and boards.

*Arilus crassipes* is about .6 in. long; rather broad; black, the pronotum, scutellum, and abdomen margined

with red. It is usually found on pine trees, feeding on plant-lice and young caterpillars, often holding them down with the front feet as a dog does his bone.

*Pselliopus* (=*Milyas*) *cinctus* is about .5 in. long; waxy-yellow with numerous, conspicuous, black rings on its legs. Like many other Reduviids, its eggs are glued to the bark of trees and covered with a water-proof substance.

*Arilus cristatus* (Plate XXV) varies from less than an inch to 1.5 in. in length; the middle of the pronotum has a longitudinal elevation something like a chicken's comb; general color grayish black, slightly bronzed. It is called the Wheel-bug. The nymphs are red, with black marks. They are our friends, if we do not handle them carelessly, as they use their beaks with good effect on many kinds of caterpillars and other injurious insects.

*Sinea diadema* is about .5 in. long; brownish; front femora, head, and pronotum largely covered with short spines. It is often found on the flowers, such as goldenrod; although it eats injurious caterpillars, it does not hesitate to attack stinging insects and so is not especially welcome near bee-hives.

### Emesidæ

These Thread-legged (not all are) Bugs should probably be placed as a subfamily of Reduviidæ. The following are our more common forms.

1. **Front** tibiæ and tarsi, together, not shorter than the front femora.....2.

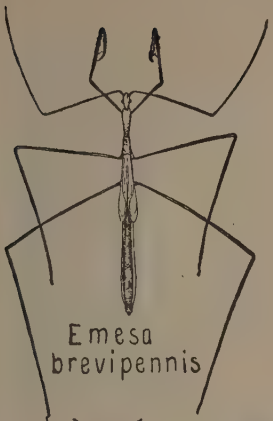
**These,** together, shorter than the front femora.....3.

2. **Eyes** large, very prominent, when seen from the side occupying the whole side of the head....*Luteva carolina.*

**Eyes** small, little prominent, when seen from the side occupying not more than half the side of the head...*Ploiariola*, of which *errabunda* is the common species.

3. **Front** tarsi 1-clawed.....*Barce.*

**Front** tarsi 2-clawed. Usually *Emesa brevipennis* (Plate XXVI). The front legs are formed for grasping, much like those of the Praying Mantis, while the rest of the



Emesa brevipennis

Phymata erosa

Corythuca arcuata

Blissus leucopterus

Lygaeus kalmii

Myodocha serripes

Anasa tristis

Podisus maculiventris

Murgantia histrionica

Euschistus variolarius

Mormidea lugens

insect suggests a delicate Walking Stick. It is called *longipes* in many publications. When full grown, it is usually at least 1.3 in. long, with wings only about a fourth as long as the legs. The ground-color is brownish, with the upper surface of the abdomen reddish and a few pale spots on each side of the head; the front legs more or less banded. It is said to feed chiefly on spiders.

### Phymatidæ

The two genera may be separated as follows: Scutellum short, head with a bifid prolongation above the insertion of the antennæ, *Phymata;* and scutellum very long, extending to the tip of the abdomen, head without such prolongation, *Macrocephalus*. We have but few species of Ambush Bugs. *Phymata erosa* (Plate XXVI) is the one most likely to be collected. Like most of the others, it conceals itself in flowers, where it captures various insects, including large butterflies and even bees. The front legs are short but very powerful, and apparently its beak is quite deadly. The generic name means "tumor" and was probably suggested by the projections from the body. The somewhat knobbed antennæ fit in grooves under the sides of the pronotum. This species is greenish-yellow, marked with a broad black band across the expanded part of the abdomen. The female is about .4 in long; the male somewhat less.

### Tingididæ

The adult Lace-bugs are small, delicate and, under a lens, beautiful insects; in most of the species the front wings and other parts, including expansions of the prothorax, are like fine lace. Furthermore, they lack the unpleasant odors of many Hemiptera. They are usually found on the under sides of leaves. The eggs are often placed near the leaf-veins. Some species, at least, hibernate as adults. Plate XXVI shows *Corythuca arcuata*, which is common on oaks. *Piesma cinerea* is our only species of the subfamily Piesminæ; they have ocelli (other Tingidids do not) and the membrane has no net-work.

### Pyrrhocoridæ

These are called Red-bugs but they are not the creatures (mites) which get in human skin and cause red sores. Our commonest species is *Euryopthalmus* (=*Largus*) *succinctus*. It is about .5 in. long and rather stout; brownish black above, with red on the margins of the prothorax, outer margin of front wings, trochanters, and bases of femora; a fine bluish pubescence underneath. The young are brilliant steel-blue, with reddish legs, and a bright red spot at the base of the abdomen. Some authorities say it is a plant-feeder and others that it feeds mainly on insects and was "found to be very useful in California by eating the destructive cottony cushion scale, at one time threatening to destroy entirely the orange groves of that state." Perhaps it does both. The Cotton-stainer of the South is *Dysdercus suturellus*.

### Lygæidæ

About 200 species have been listed from America, north of Mexico. The family has also been called Myodochidæ.

**Blissus leucopterus**

Most of us have heard of the Chinch-bug (Plate XXVI), and all of us have helped pay for it. These pests have cost the United States about half a billion dollars. The worst injury has been to small grains and corn in the Mississippi Valley but frequent injury is done in the East, especially to timothy meadows which have stood for several years. It is black and white except for the red legs and bases of the antennæ. Most of the adults occurring between the Rockies and the Alleghanies have normally long wings; in the South, East, and along the Lakes to northern Illinois, short-winged individuals are usually the more common. The young are yellowish or bright red, marked with brownish. Adults hibernate in clumps of grass or under rubbish. In early spring the females lay their yellowish-white eggs (up to 500 each) on the roots or at the bases of stalks, usually of grasses and grain. Even the long-winged adults do not fly much but usually walk from field to field. The first annual generation matures

in early summer, and eggs are then laid on the unfolding leaves of corn if these are available. This brood matures in August and September.

*Oncopeltus fasciatus* is about .6 in. long; red and black the black above being a spot covering most of the pronotum and scutellum, a broad band across the middle of the closed wings, and the membranes. *Lygæus kalmii* (Plate XXVI)—and other species—has the same colors but the black on the pronotum is at the front, the wings next to the scutellum are black, and the middle band does not go all the way across; it is about .5 in. long.

*Myodochus serripes* (Plate XXVI) "is rendered very comical by the swinging of the long antennæ with their thickened apical joint, while running over the ground among stones and rubbish of its favorite haunts. Meadows and rich soils in thin woods furnish it with needed shelter, and there it may be found throughout the entire year, half concealed by bits of twigs and dead leaves, or stowed away beneath the loose fragments of rock which lie scattered over the ground" (Uhler). The long, slender neck is quite distinctive.

### Neididæ

The Stilt-bug family has been called Berytidæ and has also been classed as a subfamily of the Coreidæ but it is probably more closely related to the Lygæidæ. There are but few species, *Jalysus spinosus* being the most common. It is about .3 in. long, with a very slender, pale body, and long, slender legs. It is rather sluggish and usually found in the undergrowth of oak woods. At first sight it suggests a tawny crane-fly.

### Aradidæ

These Flat-bugs are responsible for the notion that bed-bugs live also under bark and that they then may have wings. They are dark brown or black and the reddish, wingless young do look like bed-bugs. They probably feed on fungus. A good way to collect them is to knock dead sticks together over a white sheet. This jars off the insects and they can be seen more readily.

### Coreidæ

The Squash-bug family is an extensive one. Most of the species have an unpleasant odor, and there is a tendency to have the edges of the abdomen raised so that the wings lie in a depression.

**Anasa tristis**

The Squash-bug (Plate XXVI) is known to most gardeners who have grown any of the squash family. Its chief claim to scientific fame is that it was used prominently in the development of our present knowledge concerning the germinal relations of sex. The pronotum and the thickened parts of the front wings are speckled brown, the side-margins of the pronotum are yellowish; the hind femora do not bear a row of spines. Adults spend the winter, as well as the summer nights, under rubbish. The oval, pale-yellow to dark eggs are laid in irregular clusters, usually on the under side of leaves. The young are rather gregarious and gay with their crimson legs, head, and front part of thorax, but these change to black as they grow. In the North the adult stage is reached about August.

The following rough notes may be helpful in the Northeast. A brownish species about .4 in. long, without a row of spines on the hind femora, but with a leaf-like expansion on each antenna, is probably *Chariesterus antennator*. Species of the largely predaceous *Alydus* are usually fully .5 in. long, slender and have a row of spines on the hind femora. The following are usually more than .6 in. long and have spines on the hind femora: *Archimerus* and *Euthochtha galeator* have more or less cylindrical hind tibiæ; *Acanthocephala* and *Leptoglossus* have leaf-like expansions of the hind tibiæ.

### Pentatomidæ

The name of Stink-bugs has been fastened on this family, possibly because some of the species are responsible for giving raspberries a bad, smelly taste once in awhile. Another name is Shield-bugs, on account of the large scutellum. *Psyche*, Vol. XXII, contains a synopsis of the family with keys to the New England species by Parshley.

See the key (p. 98) for Scutellerinæ (Shield-bugs), Thyreocorinæ (Negro-bugs), and Cydninæ (Burrowing-bugs).

The Asopinæ have the first joint of the beak largely free and relatively short and thick; there is a spine on the basal abdominal segment. A common genus is *Podisus* (Plate XXVI), in which the pronotum is sometimes extended into a sharp spine on each side.

The northern subfamily, Acanthosominæ, have but two joints in each tarsus; the following subfamilies have three tarsal joints.

The Graphosominæ have a broad scutellum, which is blunt at the apex and extending back to near the tip of the abdomen. *Podops* is our only genus, and *cinctipes* (over .25 in. long, 2nd to 4th antennal joints darker) is our common species.

The principal family, Pentatominæ, has the scutellum smaller and more or less narrowed apically. The following belong here.

*Brochymena* (*quadripustulata* is a common species with us) has a shallow groove on the underside of the abdomen and the beak extends back of the posterior coxæ. They are broad, rough, brown species, .5 in. long and live on trees. They look like bits of bark and are best obtained by beating.

A medium-sized brown species with an angle on each side of the pronotum, behind, is usually a *Euschistus* (Plate XXVI). The first segment of the rostrum is not much thicker than the second, and all the tibiæ are grooved. *Chlorochroa uhleri* is a bright green bug, about .5 in. long, with yellow side-margins and a yellow tip to the scutellum. Bright green bugs larger than this are usually *Acrosternum*. *Mormidea lugens* is shown on Plate XXVI.

The popular interest in *Murgantia histrionica* (Plate XXVI) is indicated by its long list of names, among which are Harlequin Cabbage-bug, Calico-back, Terrapin-bug, and Fire-bug. It is shining black or deep blue, profusely marked with red. It feeds on cabbage and related plants, wild and cultivated. The white eggs, which are placed in a double row, look like small barrels because of their two black bands and a white spot. Adults hibernate.

## LEPIDOPTERA

Most students of insects start by collecting Butterflies and Moths and some people act as though adult Lepidoptera are the only "bugs" worth looking at. It is true that most butterflies and many moths are among the beautiful things of this earth, when they are mature, but still

> "And what's a butterfly? At best,
> He's but a caterpillar, drest."

and, until you get the right viewpoint, caterpillars are not so pretty. Personally, I think the craze for Lepidoptera is overdone. Compared with many other insects, they are uninteresting; the adults are not given to doing things much more exciting than flitting about, mating, and laying eggs in a relatively common-place way. However, it is only in comparison with some of the other insects that they are uninteresting—

> "How happy could I be with either,
> Were t'other dear charmer away!"

and, as this little book aims to obey *vox populi*, I have given Lepidoptera what seems to me relatively large—but all too small—consideration. Unless otherwise stated, the descriptions of larvæ refer to full-grown specimens, younger ones differ somewhat; and "food" means the food of larvæ.

The scientific name of this Order means "scaly-winged" and refers to the fact that the hairs which cover the wings are flattened or scale-like. It is these scales which give color to the wing, as may be seen in Plate I which shows the wings of one side denuded. We may accept two suborders: Rhopalocera and Heterocera. The "cera" in these names means "horn" and refers to the antennæ; the "Rhopalo" means "club," and the "Hetero" means "otherwise," in the same sense as when we say "Orthodoxy is my doxy and heterodoxy is another kind of doxy." Butterflies have club-shaped antennæ, a knob at the extreme end, and belong to the Rhopalocera. Moths are Heterocera: some of them, especially the males, having feathered antennæ; some having thread-like antennæ;

some having a swelling in their antennæ near, but not at, the end; while a few rare tropical species have orthodox butterfly clubs. The pupæ of butterflies are not protected by cocoons as are those of some moths and are usually called "chrysalids" (singular: "chrysalis"). Butterflies, as a rule, fly only by day when but few moths are stirring. Butterflies usually hold their wings erect, when at rest, while moths hold them flat or fold them against the body.

## RHOPALOCERA

Butterflies of the United States are grouped in five families: Nymphalidæ, Erycinidæ (p. 130), Lycænidæ (p. 131), Papilionidæ (p. 134), and Hesperiidæ (p. 142).

### Nymphalidæ

The adults of both sexes in the Brush-footed Butterflies have the front pair of legs so small as to be useless for walking and often quite inconspicuous. The chrysalids hang head-down with the tail fastened in a pad of silk.

**Anosia plexippus**

The Monarch (Plate XXVII) is the species which gathers in large flocks at the end of summer and together they move south, coming back in the spring as stragglers. The male has a small black patch on one of the veins on the upper side of each hind wing; this is a pocket containing scent-scales, a sachet bag. The adult is "mimiced" by *Basilarchia archippus*. The easily recognized larva feeds on milkweeds, fearless of birds because of its acrid taste. The pupa in its "green house with golden nails" is to be found hanging on the same plants or on some near shelter. This strong flier is rapidly becoming world-wide in distribution. Some authors use *Danais* for the generic name and a formerly used name for the species, *archippus*, is apt to be confused with the specific name of the mimic. *Anosia berenice* (The Queen), somewhat like *plexippus* but with the ground-color a rich brown, occurs in the Southwest and southward.

The Anosias belong to the subfamily Euplœinæ. In the Gulf States there is a narrow-winged species (The

Anosia plexippus
Basilarchia
archippus
arthemis

Zebra, *Heliconius charithonius*), brownish-black striped with yellow, belonging to the subfamily Heliconiinæ. This interesting group abounds in the American tropics; its members are supposed to be very distasteful to insectivorous vertebrates, and therefore to be models for numerous mimics.

The following (to p. 127) belong to the subfamily Nymphalinæ.

*Dione vanillæ* (Gulf Fritillary) comes as far north as Virginia; its wing expanse is about three inches; reddish brown above with black spots, of which a row along the margin of each hind wing are circles enclosing brown, and three near the middle of the front margin of the front wing are circular, each enclosing a white dot; below it is gloriously spangled with silver.

**Euptoieta claudia**

The upper side of the Variegated Fritillary is shown in Plate XXVIII; the under side is not silver-spotted. The larvæ feed on pansies, violets, mandrake, passion-flower, Portulacca, and other things. The chrysalis is white and black, with slightly gilded tubercles.

**Argynnis idalia**

The Regal Fritillary usually prefers swampy meadows. The male differs from the female (Plate XXVIII) in having the submarginal row of spots orange, instead of cream, and the black margin of the front wings less pronounced. Eggs are laid in the fall and the young larvæ live over winter. They feed on violets; are black and yellowish red; and have two rows of yellowish, black-tipped spines on the back, and black spines with orange bases on the sides. The chrysalis is brown, variously marked.

**Argynnis cybele**

Note (Plate XXVIII) the broad yellowish band near the edge of the under side of the hind wings of the Great Spangled Fritillary. The larvæ feed on violets and hibernate while still young, frequently having eaten nothing but their egg shells. When full grown, they are a rather velvety black with black, sometimes orange-based, spines. The chrysalis is a mottled dark brown.

**Argynnis aphrodite**

Note (Plate XXVIII) the absence of a broad yellowish submarginal band on underside of hind wing, but usually there is a narrow one and it is often difficult to tell *aphrodite* from *cybele;* they may hybridize. The life history, immature stages, and range, much like *cybele.*

**Argynnis atlantis**

The Mountain Silver-spot is much like the preceding species but is smaller, and darker at the base of the wings both above and below. On the upper side there usually is present a narrow black border to all the wings and on the hind pair the black spots in the middle are connected to form a very narrow irregular band. Below, the submarginal band of yellow on the hind wings is paler. The males have a decided odor of sandal-wood. In early stages and life history it is similar to *aphrodite* but it is more confined to mountainous regions especially in the Southeast.

There are many other species of this genus in the West, all rather difficult to identify correctly; and *Brenthis* (*q. v.*) is often united with it. *A. diana* of the Southeast is interesting because the male has the outer third of the upper side of the wings orange while the female is black with blue spots. As a rule, larvæ of this genus have the front spines the longest; they feed chiefly at night. The chrysalids have a forked head.

**Brenthis myrina**

Although the upper side of the Silver-bordered Fritillary is tawny with black markings and resembles *B. bellona,* the species are easily distinguished by the fact that *myrina* is rich in silver spots on the under side of the wings (Plate XXIX). Its larvæ feed on violets, and after hibernating get to be about an inch long; they are dark olive brown with lighter markings and are covered with fleshy spines. Chrysalis: dark with darker spots and somewhat curved forward.

**Brenthis bellona**

See Plate XXIX and the description of *myrina.* The Meadow Fritillary has no silver underneath. Its life-history is much like that of *myrina.*

The chrysalids of *Brenthis* have two rows of conical

Euptoieta claudia
A. cybele
Argynnis aphrodite
Argynnis idalia

tubercles on their backs. *B. montinus* is interesting because it is found only on, or near, the summits of the White Mountains; the underside of the hind wings is much darker than in *myrina* and the silver spots are not so large or so numerous.

**Phyciodes nycteis**

See Plate XXIX and discussion concerning *Melitæa harrisi*. The wings of the Silver Crescent are tawny-orange, lighter on the under side, and marked with black; the hind wing, below, is largely silvery white; the usually imperfect "crescent" is along the margin. The larvæ, which feed on sunflowers and other Compositæ, are brownish-black with a rather conspicuous orange stripe along each side; many rather short, black, hairy spines. Although the larvæ hibernate, they do not seem to construct a shelter; probably they crawl into a "ready-made."

**Phyciodes tharos**

The variable Pearl Crescent has two broods: those adults which come from over-wintered larvæ are (among other differences) brighter and with more distinct light markings on the under side (variety *marcia*, Plate XXIX) than those which develop during the summer. By chilling the pupæ we can cause some of the summer brood to be *marcia*. The larvæ feed on asters and are black with yellow spots above, yellow side-stripes, and yellowish spines. The slightly angulated chrysalis has brownish creases on a light ground-color, and, on the middle of the abdomen, a slight transverse ridge.

*Phyciodes batesi* differs from *tharos* by having heavier black markings above and by the lack of conspicuous dark markings on the lower side of the hind wings, these being almost uniformly pale yellow. There are many other species in the West.

**Melitæa phaëton**

The adult Baltimore (Plate XXIX) is found in swampy meadows during June and July. The wings are nearly black, marked with red and pale yellow. The larvæ, which feed chiefly on Scrophulariaceæ, are dark orange, ringed with black, and covered with short hairy spines. They hatch

in late summer and are gregarious, spinning a silken tent in which they pass the winter; in the spring they scatter and become full grown by June. The chrysalids have a rounded head, sharp tubercles on their backs, and are whitish with dark and orange markings.

**Melitæa harrisi**

Resembles *Phyciodes nycteis* on the upper side, but the underside is darker and has a continuous row of silver spots along the outer margin of the hind wings. The larvæ feed on the aster, *Doellingeria umbellata;* they are reddish with a black stripe down the middle and nine rows of black, branched spines.

The species of *Grapta* are called Angle-wings; they "look as if Mother Nature had with her scissors snipped the edges of their wings, fashioning notches and points according to the vagaries of an idle mood." They are tawny, with darker markings above, and below there is a combination of brown and gray which corresponds closely with the color of dead leaves. The chrysalis has a forked head and a prominent tubercle on the back of its thorax. All of the species hibernate as adults, hidden in hollow logs and similar places.

**Grapta interrogationis**

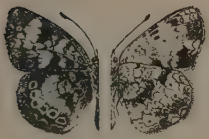
By stretching your imagination a bit you may see a Question Mark made by the silver spots on the under side of the hind wings but they look to me like (. and I think Fabricius had some other question on his mind when he named the species *interrogationis*. It is also called Violet-tip, because of the violet Papilio-like tail. The summer form (*umbrosa*) has the dark markings on the upper side "clouded." Plate XXX shows the winter form, *fabricii*. The larva feeds chiefly on hop and elm; it has a pair of branched spines on the tip of its head and others on its body; it is chestnut-colored with light dots in longitudinal rows. Like other *Grapta* larvæ, it frequently cocks its head when not feeding. The chrysalis, which is the color of dead leaves, is very angular and has a "Roman nose" on its thorax: in addition, the thorax bears one or more pairs of metallic silver or gold spots.

Brenthis myrina

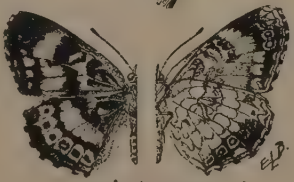
Brenthis bellona

Melitæa phaëton

Larva and tent of M. phaëton



Phyciodes tharos



Phyciodes nycteis

**Grapta comma**

Harris, a pioneer American entomologist, named the species from the silver mark on the under side of the hind wings (Plate XXX); and Edwards, one of our earliest and greatest Lepidopterists, named the lighter hibernating form *harrisi*, in his honor, calling the darker summer form *dryas*. The larva feeds on hop, nettles, and related plants, slightly rolling the leaves for its protection while eating; its color varies from brown to greenish white. "The angulated chrysalis closely resembles that of its allies of the same genus; it is pale wood-brown, tinged and streaked with pale green; the base of the tubercles along the back is of a metallic color, both in this species and in the Violet-tip (which it most resembles), and according to whether the color is silvery or golden, so will the price of hops (on which both are found) be high or low, according to the hop-growers; and so these chrysalids are termed Hop-merchants."

**Grapta progne**

This species (Plate XXX) is called Gray Comma; its under side is grayish and its "comma" is tapering at the ends. The larva feeds on currant, gooseberry, etc.; it is spined much like the Violet-tip but the body is yellowish brown, variegated above with dark green. The chrysalis is a striking mixture of buff, olive-green, brown, salmon, and white.

The larva of *G. faunus* feeds on birch, willow, currant, and gooseberry; the adult's wings are deeply notched and the under side of the hind wings, each of which has a silver mark like *comma*, are strongly tinted with green along the outer third—the "leaf" is not quite dead! It is an inhabitant of mountains as far south as the Carolinas.

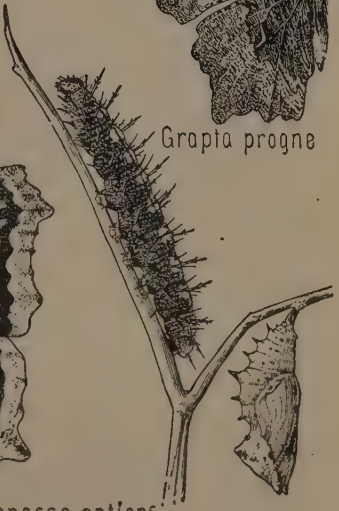
**Vanessa antiopa**

The English name is Camberwell Beauty and, while rare in England, this species (Plate XXX) is found throughout the temperate regions of the world and gets as far south as Guatemala. We call it Mourning Cloak. It is the largest of those of our butterflies which hibernate as adults, and he who has not seen it flitting in the leafless woods of very early spring or "resting on the black willows, like a leaf still adhering" is indeed unfortunate. Just inside the

Grapta interrogationis

Grapta comma

Grapta progne



Vanessa antiopa

yellow margin of the upper side is a row of blue spots; the under side is the color of dead leaves. The eggs are laid in masses encircling the twigs of the willows, poplars, and elms upon which the velvety-black larva, with orange-red spots, feeds. The chrysalis is yellowish brown, with darker markings and red-tipped tubercles.

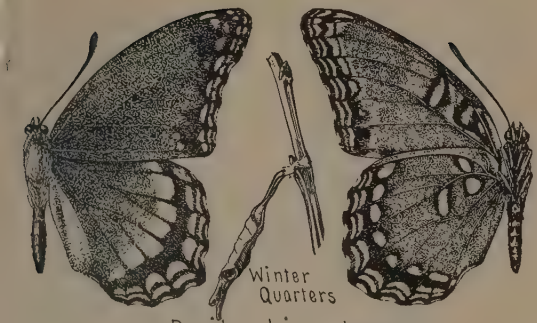
*Vanessa* (or *Grapta*) *j-album*, Compton Tortoise, is slightly smaller than *antiopa*, tawny orange above with (among other markings) three large black patches and a spot of white along the front margin; below, ashy brown with a white J or L on the hind wings. *V. milberti*, American Tortoise-shell, is very dark brown above with two tawny orange spots near the middle of the front margin and a broad band of similar color across each wing; under surface slate-brown; expanse, two inches or less. Both are northern insects; the larva of the former feeds on birch, and of the latter on nettles.

**Pyrameis atalanta**

The Red Admiral is found throughout most of the northern hemisphere. The upper surface is purplish black with markings as shown in Plate XXXI, the lightly shaded areas being bright orange and the apical spots white; the under surface of the hind wings is marbled and marked with wavy lines of intricate pattern and also with a green-dusted submarginal series of obscure "eye-spots." The larva, which feeds on nettle and hop, is usually black, spotted with yellow, and, like *V. antiopa*, the larvæ of this genus have no spines on their heads. The larva slightly rolls, and lines, a leaf for its protection. The chrysalis is ashy brown with golden spots and is to be looked for (but not always to be found) hanging in a leaf which the larva has rolled. Winter is passed in either the pupal or adult stage; it is two-brooded.

**Pyrameis huntera**

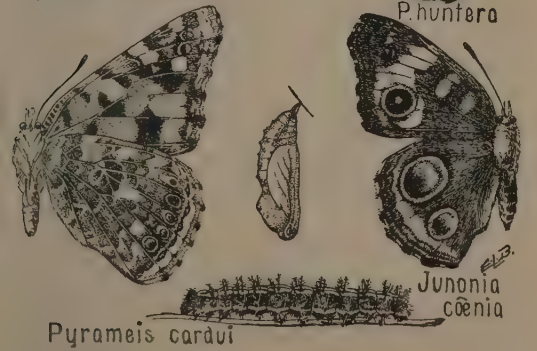
This species is sometimes called Hunter's Butterfly or Painted Beauty. The upper surface is tawny orange and brownish black, except for the white spots shown in Plate XXXI; the under side of the hind wings has *two* eye-like spots. The larva feeds on various "everlastings" and is velvety black




Basilarchia astyanax

Pyrameis atalanta

P. huntera




Junonia
cœnia

Pyrameis cardui

with narrow cross lines of yellow and a row of white spots on each side. At first it makes a mat, under which it feeds, of silk and the hairs of its food plant; later it fastens leaves together and often pupates in this nest. The chrysalis is difficult to describe. Find it. There are two broods a year but pupæ are to be found from June to March, although the adult usually emerges early and hibernates.

**Pyrameis cardui**

I like "Thistle Butterfly" better than "Painted Lady" since this lady "was born that way." The upper side is much like *huntera;* below, however, the hind wings (Plate XXXI) each have more than two, usually four, good eye-spots. The head of the larva is hairy on top; the body is greenish yellow, mottled with black, and the bristly spines are yellowish. It feeds on burdock, thistle, sunflower, hollyhock, and other plants, making a shelter much like that of *huntera.* The chrysalis is greenish or bluish white, marked with black and brown, and with tubercles which are often gold-tipped. This species is found throughout the habitable world with the exception of South America. It occasionally migrates in swarms.

**Junonia cœnia**

The upper surface of the Buckeye (Plate XXXI) is dark brown with conspicuous peacock-like eye-spots, small orange spots, a dull whitish band on each front wing and a narrow but conspicuous band of yellowish orange on each hind wing; the under surface is gray-brown with much the same markings except that the eye-spots of the hind wings are much reduced. The larva feeds on plantain, snapdragon, and *Gerardia;* it is dark gray, with yellow stripes and spots, and with purple spines, one pair of which is on the head. It is a southern species which gets as far north as New England.

**Basilarchia astyanax**

The upper side of the Red-spotted Purple is black and pale blue or green; the lower side is brown with a submarginal row of red spots, two red spots at the base of the fore wings, and four at the base of the hind wings. The curiously shaped larva is mottled with brown, olivaceous, and cream; it feeds on

the leaves of a variety of woody plants, especially willow and wild cherry. When young, it is much given to eating each side of the outer end of a leaf and using the midrib, strengthened with silk, etc., as a perch on which to rest. When about half grown, it rolls the uneaten portion together, lines it and fastens it to the twig with silk, and passes the winter in this snug retreat. Scudder describes the chrysalis as "grotesquely variegated with patches and streaks of pale salmon, dark olivaceous, inky plumbeous, and yellow-brown, the lighter tints prevailing." The name *Limenitis* is often used instead of *Basilarchia* and this species is sometimes called *ursula*. There are apparent intergrades between this and the following species.

**Basilarchia arthemis**

Plate XXVII gives a sufficient description of the upper side of the Banded Purple; the under side is dark brown with similar markings and some orange spots in addition. The larva feeds on birch, willow, poplar, etc.; it is somewhat like *astyanax* (but has a saddle of pale buff) and has similar habits. Like some other young butterflies, it loosely fastens a small ball of leaf-scraps near its feeding place; this is supposed to distract an enemy's attention from itself. This Canadian species reaches into northern United States in the high altitudes.

**Basilarchia archippus**

Plate XXVII shows the Viceroy, which is also called *disippus*, in three of its stages. *Anosia plexippus* is believed to have a taste which birds do not like and, as that species has a very striking appearance, any species which resembles it would be likely to be unmolested by them. *B. archippus* is said to "mimic" *A. plexippus* for the sake of this protection but that implies more than we know, all of which is that the two look marvelously alike and that *archippus* has departed widely from the appearance of its relatives. Plate XXVII was arranged to illustrate vividly this case of "mimicry," *arthemis* being taken as an example of the relatives of *Basilarchia*. Equally striking instances of the same phenomenon are known in tropical butterflies. The larva, which feeds on willow and poplar, varies greatly in its coloration.

Skipping a number of species which are not likely to be seen by many users of this book, we come to the subfamily *Satyrinæ*, the Nymphs and Satyrs, sometimes more descriptively called the Meadow-browns. Their larvæ have the last segment forked and the chrysalids are rounded.

**Debis portlandia**

The brown of Pearly Eye's wings (Plate XXXII) has been described as "clay," "soft," "Quaker drab" and "with pearly gray tints." The spots on the under surface are distinctly eyed and there are conspicuous pearly violet markings. The larva is yellowish green with red-tipped horns and caudal forks; it feeds on grasses and hibernates when about half grown.

**Satyrodes canthus**

The color of the upper side of the Grass Nymph's wings (Plate XXXII) is described as "mouse-brown"; below it is slaty brown and the eye-spots are larger than those on the upper surface. The tubercles on the head of the green larva are red, striped with brown, and the tails are also red; it feeds on coarse grasses and sedges and, unlike its near relatives, is active by day. It is rather local in its distribution, preferring moist meadows.

**Neonympha eurytus**

This lover of shady forest-edges, the Little Wood-satyr (Plate XXXII), is dark brown above and lighter below, where the eye-spots are more distinctly ringed with yellow. The larva is greenish white, marked with brown, but there is no red; it feeds on grasses.

*Neonympha phocion* is a southern relative of *eurytus;* it has no spots above and the three (or four) spots on the underside of the hind wings are so narrowed that they might be called squint-eyed. The reader may find other species of this genus but will recognize them as Satyrinæ, at least.

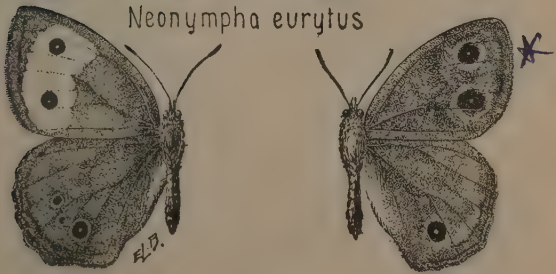
**Satyrus alope**

The dark brown Common Wood-nymph (Plate XXXII) has several varieties, which are sometimes considered to be distinct species. The form in which the yellow bands on the fore wings are

Debis portlandia

Satyrodes canthus

Neonympha eurytus



Satyrus alope

variety nephele

clouded with brown is called *nephele* and replaces *alope* in the north, New York City being in the tension zone. Together, they and other varieties of *alope* cover practically the whole of the United States and Canada. Along the Atlantic coast some individuals (called *maritima*) have the yellow band orange. The green larva has no "horns" on its head and is devoid of markings except for two pale stripes on each side; it feeds on grasses.

**Libythea bachmani**

The figure of the Snout-butterfly (Plate XXXIII) saves further description. The "snout" is made up of elongated palpi—a characteristic of the subfamily Libytheinæ, of which this is the only representative in the Northeast, and probably other U. S. forms are merely varieties. Curiously enough, the males have only four usable feet although the females have six. The larva feeds on hackberry and wolfberry; its last two thoracic segments are slightly thickened; this "hump" bears two black tubercles ringed with yellow; the general body-color is green and there are three longitudinal stripes of yellow.

## Erycinidæ

According to the system followed here, the same as is used by Holland in his *Butterfly Book*, all the species thus far considered belong to the family Nymphalidæ. We come now to the Lemoniidæ or Erycinidæ, a family whose chief home is the American tropics. Their common name is Metal-marks. The same sexual difference in legs as was noted in the Libytheinæ and as exists also in the Lycænidæ holds here. All the Nymphalid chrysalids hang by their tails; the Erycinid chrysalids have their tails fastened but they also have a silken support for their backs which holds them upright.

**Calephelis borealis**

The Northern Metal-mark (Plate XXXIII) ranges from South Carolina to New York and Michigan and is the only Erycinid to be found so far north; a somewhat similar but smaller species (*C. virginiensis*, not *cœnius*) is found just south of it.

LYCÆNIDÆ

The Hair-streaks, Coppers, and Blues puzzle even the professional. Legs ("more or less") and method of hanging chrysalids are as in Erycinidæ, but the Lycænidæ have neither a costal nor a humeral vein in the hind wings. Please do not ask any more questions just now but see Plate XXXIII, which will give you a general notion of the appearance of these creatures. The larvæ are flat and something like slugs.

**Thecla melinus**

The larva of the Common or Gray Hair-streak feeds on the developing seeds of hop, beans, *Cynoglossum*, *Hypericum*, and other plants. Plate XXXIII shows the adult. In the Southeast there are two species whose upper sides somewhat resemble *melinus: T. wittfeldi*, which is larger and has conspicuous blue scales at the rear angles of its hind wings; and *T. favonius*, which has a red spot on each fore wing.

**Thecla damon**

The larva of the Olive Hair-streak feeds on cedar, but not smilax as some books say. The species is found in the East from Ontario to Texas, and several varieties have been described. Plate XXXIII shows that the adult is greenish *below*. *T. halesus* (Illinois southward) is iridescent bluish-green *above* on the thorax and basal half of the wings; below, the front wings are nearly plain; all of the wings have a crimson spot near the base and there are three rows of green spots on each hind wing. *T. m-album* (New Jersey and Wisconsin southward) is bluish on the inner half of the upper surface but, below, each fore wing is crossed by two lines of white, one of which is continued on the hind wing and is M-shaped at the rear. The larvæ of both feed on oak.

In addition, the following have more or less safe (for the Northeast) catch characters:

Hind wings with long tails.

*T. cecrops:* a red band across the lower surface of the wings just beyond the middle; New Jersey and Indiana southward; larva unknown. *T. calanus:* a double row of

close, dark, blue-edged spots just beyond the middle; Quebec to Colorado and Texas; larva on oak, chestnut, and walnut. *T. liparops:* numerous, broken, white cross-lines on under surface; north of the Gulf States to Quebec and the Rockies, not common; larva on *Vaccinium* (other food records are probably erroneous).

Hind wings with almost, or quite, no tail.

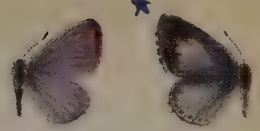
*T. titus:* a row of coral-red spots on under side of hind wings; Canada to Florida and the Rockies; larva on plum and wild cherry. *T. niphon:* fringe of upper side of wings alternately brown and white, under side of wings rich, mottled brown, with distinct wavy white lines; larva on pines; Nova Scotia to Colorado. *T. augustus:* expanse less than one inch (smallest of the group), below uniform rusty brown except for darker basal area of the hind wings; larva on *Kalmia* and *Vaccinium;* North Atlantic States, northward and westward.

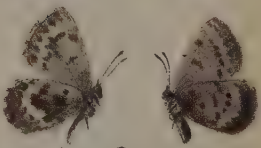
Probably all the *Thecla* larvæ are attended by ants for the sake of their sweetish excretions and *titus*, at least, regularly passes the day in ants' nests, feeding by night.

**Feniseca tarquinius**

Scudder, the Master Lepidopterist, in whose works most of the statements concerning butterflies which are given in this and similar books are to be found, used "The Wanderer" as the nickname for this species (Plate XXXIII) but says in *Everyday Butterflies* that it is "a very local insect, and apparently never wanders more than a few rods from its birthplace." Holland, who has done so much to popularize the study of Lepidoptera, uses as the English name "The Harvester," but harvesting connotes vegetable products. I am taking the liberty of dubbing it The Carnivore because its larva alone, of all our butterflies, is regularly a meat-eater although its relatives, if pressed by hunger, will eat each other. The female lays her eggs, usually singly, in, or near, masses of aphids (plant lice), especially of the woolly aphis of the alder. The larva has mandibles with four sharp, claw-like teeth and the whole mouth is fitted for sucking the body fluids of the victims. If aphids are the ants' cows, *tarquinius* is a beef-eater.

Lycaena comyntas





Lycaena ladon

Chrysophanus hypophlaeus

pupa

Feniseca tarquinius

Thecla melinus

Thecla damon

Libythea bachmani

Calephelis borealis

Possibly in order to hide from the ants, which might resent their ravages, the larvæ live in a silken web which they spin and cover with empty "hides." Possibly it is this strong diet which quickens the metamorphosis, for the larva reaches the pupal stage in three, instead of four or five, molts. Scudder points out a resemblance to a monkey's face in the markings of the chrysalis (enlarged in Plate XXXIII). This species, whose nearest relatives live chiefly in Asia and Africa, is found from Nova Scotia to the Gulf States and in the Mississippi Valley. It should be said that the markings on the upper side of the adult are variable; the under side is paler and the hind wings have many small light-brown spots not appearing above.

**Chrysophanus hypophlæus**

There are other American Coppers—butterflies, I mean,—but this species (Plate XXXIII) was once "really-named" *americanus*, hence the "common" name. The adult is a fearless, pugnacious, active, little beauty. The larva feeds on sorrel (*Rumex*). Pupation usually takes place under an over-hanging stone, in which condition one brood passes the winter.

**Chrysophanus thoe**

The Bronze Copper is about half again as large as *hypophlæus;* the female resembles that species on its upper side except that the dark base of the hind wing does not extend out so far; the male differs from both in having the upper surface of the front wing almost as dark as the base of the hind wing and with a violet reflection. The larva feeds on *Rumex*. There are two annual broods, and winter is passed in the egg. Ranges from Maine to Pennsylvania and Colorado.

**Lycæna comyntas**

The delicate hair-like tails of the Eastern Tailed Blue (Plate XXXIII) will repay close examination; they have a white tip. The female is largely dark brown above. The larvæ feed on clover and other Legumes, those of one of the three annual broods hibernating.

**Lycæna ladon**

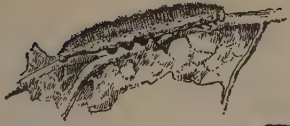
The Common Blue is also called *pseudargiolus* and the Spring Azure. Small, blue butterflies are pretty sure to be this species, if they have no tails; but it is a creature of many fashions, some of which are shown in Plate XXXIII. These forms are partly sexual, partly seasonal (there are two broods around New York), partly climatic, and probably partly something else. The larvæ feed on the flowers of various plants including *Cornus*, *Cimicifuga*, *Actinomeris*, *Spiræa*, and *Ceanothus*. Ants attend the larvæ and, by touching them with their antennæ, induce the larvæ to excrete from abdominal glands a sweet fluid which the ants drink.

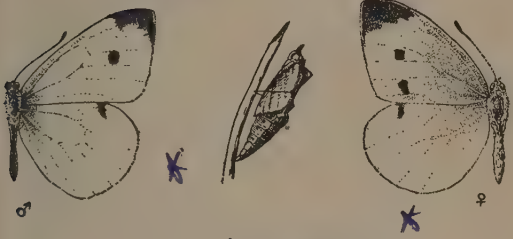
### Papilionidæ

Both sexes of the Swallow-tails and their relatives have, normally, six good walking legs. The chrysalids have a silk supporting strap around them but it does not hold them as closely to the surface upon which they are fixed as in the Erycinidæ and Lycænidæ.

**Pieris rapæ**

This undesirable immigrant, the Imported Cabbage-butterfly (Plate XXXIV), is the *only* butterfly which seriously injures our crops. It was accidentally introduced from Europe in 1860 at Quebec and in 1868 at New York; in twenty years it covered about half of the United States and Canada; now no cabbage patch from coast to coast is too small or too isolated for *rapæ*. The well-known green larva feeds on a variety of cruciferous plants but likes cabbage best—Thank you! There are usually three broods a season, winter being passed as a chrysalis from which adults emerge early in the spring before the native cabbage butterflies are stirring. These early spring adults are smaller and less heavily marked than the summer form, which is here illustrated. Some individuals (variety *immaculata*) are without the black spots on the upper side of the wings but the underside of the hind wings are yellowish as in the typical form.






Pieris rapæ

Pieris protodice

P. napi oleracea

Euchloë genutia

Largely White Butterflies

**Pieris protodice**

The Checkered White (Plate XXXIV) is also called the Southern Cabbage Butterfly and used to be called the Common White but, like our other native cabbage-feeders, its numbers are diminishing as those of the foreigner increase. The larvæ feed on crucifers and, when they get a chance at cabbage, they merely eat the outside leaves, which are not worth much at any rate. The veins on the under side of the female's wings, especially the hind ones, are tinged with greenish yellow. Those adults which come from overwintered chrysalids (var. *vernalis*) have so much greenish gray on the hind wings that the white is reduced to narrow triangular spots; spots on the upper side are much reduced, or even absent.

**Pieris napi**

The larva of the Old-fashioned Cabbage-butterfly now feeds on such crucifers as it can get, but it is said to have been *the* Cabbage Butterfly. Some call it the Mustard White; some, the Gray-veined White. The Comstocks say "The species is essentially northern, but it spread far south when *Pieris rapæ* was introduced. In some way the European species has greatly reduced its numbers; it has literally taken to the woods as a result of this invasion and is seldom found elsewhere." It is naturally (not by human intervention) found in Europe and throughout North America as far south as the Gulf States, but it varies greatly with region and season. Plate XXXIV shows the form you are most likely to see. To quote the Comstocks again: "Evidently this species has not concluded whether it will in its final form be all white; or have the front margins and tips of the front wings blackish; or have one spot on each front and hind wing; or have one black blotch along the wings outside the middle; or if it will have the veins of both wings above penciled with gray."

In the Gulf States there is *Pieris monuste*, which has a wing expanse of from 1.75 to 2.3 inches; the male is whitish above, except for a narrow brown outer margin to the fore wings; the female has a broad brown outer margin on the fore wings, as well as a narrow brown outer margin on the hind wings, above.

Do not be disturbed if you see the generic name *Pontia* instead of *Pieris;* it is probably better. See also *Colias* for a white butterfly which may confuse you.

**Euchloë genutia**

Plate XXXIV shows the male Falcate Orange-tip, the orange tip being indicated by shading. The female has no such tip on the upper surface and neither sex has it below, the markings there being light greenish brown. The larva, which feeds on rock-cress, shepherd's-purse, and other Cruciferæ, is bluish green, with pale dorsal and side stripes, but, if you look closely, you can see fine stripes of other colors.

**Colias philodice**

Probably you have noticed that, among a flock of yellow butterflies, the Common Sulphurs, which rises from a roadside pool as you pass, there is sometimes a white individual. This is usually an albino *philodice* and, if so, almost certainly a female. However, even when white, the species can be distinguished from *Pieris* by the silvery-centered spots on the under side of the wings (see Plate XXXV). The common, but rarely noticed, green larvæ feed upon clover leaves.

*Colias eurytheme* is about as variable as *P. napi* but can usually be recognized by the strong orange tint of the yellow on the upper side and the marginal markings which suggest *philodice*. Its larva feeds on clover.

**Meganostoma cæsonia**

Most of us will agree with the Comstocks that the "face" of the Dog-face (Plate XXXV) is more like that of a duck than of a dog. However, it makes the species easily recognizable. You may find it listed in some books under *Colias* or *Zerene;* in nature you will find it from Pennsylvania (very rarely) and southern Wisconsin to the Gulf States. Its larva feeds on false indigio (*Amorpha*) and (?) clover.

*Catopsilia eubule:* Nearly every year strong-flying individuals of this southern species get even further north than Long Island; it has a wing expanse of 2.5 inches;

the male is plain yellow above, and the female has a row of dark brown spots along the outer margin of the front wings and a somewhat similar spot in the center of these wings. The larva feeds on *Cassia* and other legumes.

**Terias lisa**

The Little Sulphur may be recognized by means of Plate XXXV; the female is paler on the upper side than the male and the black border of the hind wing is much broken or nearly absent. The larva feeds on *Cassia* and there are three broods, but we are not sure how our northern winters are passed. My guess would be that they are passed in the South, after the fashion of *Anosia plexippus*. In this connection it should be said that "clouds" of the autumn brood of adults have been noted as landing on Bermuda from the northwest, having covered six hundred miles of ocean. Albinic individuals are sometimes found.

*Terias nicippe* is much like *lisa* but somewhat larger; the front wings of both sexes are tinged with orange and the hind wings, especially of the female, have short, but rather broad, cross-spots of iron-rust color. The larval food and (?) life history are the same as *lisa*. In the Gulf States there are three rather common species (*elathea*, *delia*, and *jucunda*) which cannot be differentiated in a few words; they may be known collectively by being something like *lisa* but with a conspicuous dark band along the hind margin of the front wings, upper surface. This generalization, however, includes *Nathalis iole*, which occurs from southern Indiana to Colorado and northern Mexico. Its small size (wing expanse of not over 1.25 inches) helps one to "spot" it.

The Sulphurs and Whites are classed together as the Pierinæ. The Swallow-tails (*Papilio*) and the western genus *Parnassius* make up the subfamily Papilioninæ.

**Papilio cresphontes**

This is the Giant Swallow-tail. The adult shown on Plate I is smaller and somewhat duller than the average. The form of all of the stages shown is typical of Papilios. In the South it is called Orange Dog because its larva feeds

Colias philodice

Terias lisa

Meganostoma cæsonia

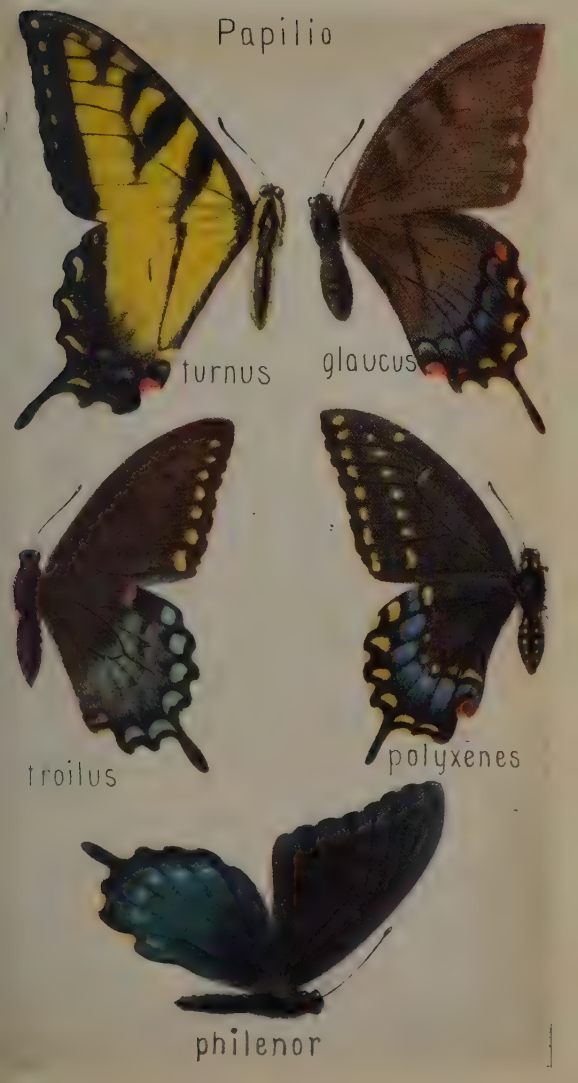
on citrus leaves, and some authors use *thoas* as its specific name, but this should be applied to a more southern species. The horns on the larva are fleshly affairs, which may be withdrawn or extruded through a slit in the thorax; not only is their sudden appearing supposed to frighten the larva's enemies but these horns exhale an odor which, in some species, is quite disagreeable—in other words, the young of the beautiful creatures are insect skunks. The meaning of the color on the right side of the adult, as shown in Plate I, is explained on p. 115. The wings are more largely yellow below than above. The home of this species is the North American subtropics, but it seems to be working northward (where the larva feeds on prickly ash and *Ptelea*) and has been taken in Canada. There are from two to four annual broods, depending upon location.

**Papilio glaucus and var. turnus**

One of the rules about scientific names is that the first name used for a species, if accompanied by a description, shall be *the* name. Now Linnæus evidently intended to call the yellow Tiger Swallow-tail *turnus*, but, in his description, he first referred to the dark form of the female (Plate XXXVI), which is rare in the North but common in the South, as *glaucus;* therefore *glaucus* is the name of the species, but you may call it *turnus*. The larva feeds on orchard and other trees, especially wild cherry, but is never injurious. It has the luxurious habit of spinning a web on top of a leaf, drawing it so tightly that it has a spring couch upon which to rest when not feeding. There is a pair of eye-like spots on the thorax, and, when the true head is drawn under so that these appear to be on the head, the thoracic "horns" are shot out, and the front part of the body is swayed back and forth, even you might hesitate to disturb its siesta.

**Papilio troilus**

The Spice-bush Swallow-tail is sometimes called the Green-clouded Swallow-tail because of the color of the upper surface of the hind wings; the female does not have the green so pronounced but has hazy blue spots along the cloud's outer


Papilio
turnus
glaucus
troilus
polyxenes
philenor

margin (Plate XXXVI shows the male); below, the front margin, at least, of the green cloud is replaced by a row of orange spots. The larva feeds chiefly on sassafras and spice-bush (*Benzoin*); it makes a series of successively larger shelters for its resting times by folding a leaf at the midrib, fastening the fold by silk threads placed near the crease instead of at the edges. It keeps these shelters scrupulously clean, eating its cast skin, when it molts, except that it throws out the inedible cast "skull."

**Papilio polyxenes**

A sometimes-used scientific name, *asterias*, is also the common name. Plate XXXVI shows the female; the male is not so dark, his blue spots are not so pronounced, but his yellow spots on the inner row are much larger. The larva is wasteful; it eats our parsley and carrots, instead of sticking to umbelliferous weeds, and does not eat its cast skins as do its near relatives; otherwise it is a beautiful creature which, like many of its relatives, changes the color and cut of its dress at every molt, and which will stick out its orange horns if you but threaten to poke it. The species is found throughout the Atlantic States and the Mississippi Valley; what have been considered races of it extend this distribution to most parts of North America and south to Cuba and Peru.

**Papilio philenor**

Plate XXXVI shows the male Pipe-vine Swallow-tail; the female has a row of distinct spots on each fore wing, corresponding to those on the hind wings. The inner margins of the male's hind wings are folded over and contain scales which give off a faint odor, presumably for the sake of pleasing the female. It should be said that many male Lepidoptera have similar scent-scales, placed in various parts of the wings, body, and legs. The larva of *philenor* feeds on the Dutchman's-pipe (*Aristolochia*) and differs from most of its relatives by having, even when mature, fleshy spines on several of the front and rear segments. Instead of depositing her eggs singly, the female lays them in little bunches; and the larvæ, when young, feed side by side at the edge of a leaf.

*Papilio palamedes* (wing-expanse, 4 to 4½ inches) suggests a giant *polyxenes* in which the inner row of yellow spots on the upper surface of the hind wings is a continuous band and there are three yellow spots near the front between two rows on the fore wings. Its normal range is from Virginia and Missouri to Florida and Texas, its larva feeding on Magnolia and Lauraceæ.

*Papilio marcellus* (formerly called *ajax*) suggests *turnus*, but has tails twice as long, is white instead of yellow, has more black on the upper surface and, in addition, a red spot or two near the middle of the inner (hind) margin of the hind wings. It is found almost everywhere that its larval food (papaw) occurs in the eastern half of the United States.

We have other species of *Papilio*, especially in our West and Southwest; some having no tails (e. g. *polydamas*, which also carries perfume, of Florida), some two tails (e. g. *daunus* of the western mountains), and the rare *pilumnus* of Arizona having three tails.

### Hesperiidæ

I fear that Plate XXXVII will be exasperating to those attempting to start an acquaintance with this interesting but most difficult family. However, there has been but little call for information concerning them, and there are so many species that a great number must necessarily be omitted. There are at least fifty species in New Jersey—other regions are also well, many better, supplied, about 2000 species having been described. The adults are, for the most part, small and fly with rapid starts and stops, as is indicated by their nickname, Skippers. When resting, many of them (especially the Pamphilinæ) hold the front wings at an angle different from that of the hind pair. Both sexes have six feet; their eyes are overhung with curving "lashes" and the antennæ of many species are hooked at the tip.

The larvæ are smooth and usually have a head, somewhat rough and hairy, which looks too big and seems to be supported by a too slender neck. The appearance of many suggests moth larvæ, and nearly all of the species

show a further resemblance to moths in that they spin a sort of cocoon within which they pupate. This cocoon is never very thick or complete and is merely a further development of a habit of the younger larvæ; still, it is more of a cocoon than some moths make. The habit, just referred to, consists of folding leaves or fastening several together with silk so that the larvæ may have a retreat when resting or molting. All species keep these nests quite clean and some have interesting little tricks about their homes. Scudder notes that *Thanaos icelus*, which folds over part of a leaf, fastens it at first with long strands of silk so that there is an "abundance of space for air, or, indeed, the entrance of nearly any enemy"; but, when the time comes for one of the several changes of clothes, the larva brings the edges of the leaf tightly together and fastens them securely. Many species make a new nest, out of a different leaf, at each molt, and the same keen observer noted that *Thanaos lucilius*, "when it leaves a nest to form a larger one always first bites off the strands which have kept the old flap in place."

Reference has already been made to the fact that many male Lepidoptera are addicted to the use of perfume. Among the Hesperiidæ, the males of the subfamily Hesperiinæ tend to have the scent-scales (androconia) in a tiny fold along the front margin of the fore wings; in the subfamily Pamphilinæ these scales are near the middle of the upper surface of the fore wings in a conspicuous patch, which the Comstocks described as looking "to the naked eye like a scorched oblique streak or brand."

The following notes concerning a few species (together with Plate XXXVII) will help start you off, if you wish to go, but one difficulty is that a given sex often resembles the same sex of a different species more closely than it does the opposite sex of its own species; furthermore, the same sex often has one or more varieties.

### Hesperiinæ

*Epargyreus tityrus.* The light marks are yellowish except for the large silver spot on hind wing. Larva on locust (*Robinia*), etc.

*Eudamus proteus.* About the size of *E. tityrus* but each hind wing has a long tail; greenish on hind wings, especially of males. American tropics to (rarely) New York. Larva on Legumes.

*Achlarus lycidas* suggests *tityrus* but has no tails; it has no silver spot beneath, but a white smear along outer margin of hind wings. Larva on tick-trefoil (*Desmodium*).

*Thorybes bathyllus.* Adults have white faces. Larva on bush-clover (*Lespedeza*) and other Legumes. *T. pylades* is much like *bathyllus* but the spots are smaller and the face is brown. Larval food the same.

*Hesperia tessellata.* Appears to be a white butterfly strongly marked with black. Larva on *Sida.*

*Thanaos juvenalis:* general color blackish brown with black mottlings and white, semitransparent dots; larva on oaks and Legumes. *T. brizo* is about the size of *juvenalis;* it lacks the white dots, has two distinct rows of arrow-head, black marks on each front wing, and has more gray scales. Larva on oaks and probably Legumes. *T. lucilius* is about half the size of these; it has minute but distinct white dots on the front wings. Larva on columbine (*Aquilegia*).

*Pholisora catullus* is much like *T. lucilius* but is blacker, the white lots are more scattered, and it lacks the mottlings of *Thanaos.* Larva on lamb's quarters (*Chenopodium*) and Amarantaceæ.

## Pamphilinæ

In this subfamily, however the sexes may differ above, they are much alike below. Except where stated, the light areas, on the species mentioned here, are yellowish.

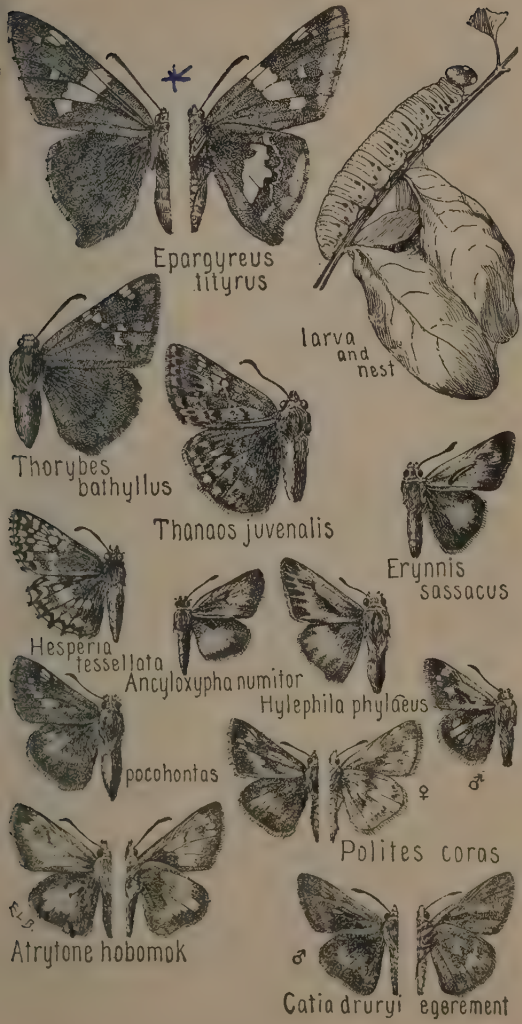
*Ancyloxypha numitor.* Larva on marsh grasses.

*Erynnis sassacus.* Larva on grasses.

*Catia druryi egeremet.* The light areas are greenish yellow. Larva on grasses. New England to Wisconsin and our southern border.

*Polites coras* and *Hylephila phylæus.* Larvæ on grasses.

*Thymelicus mystic* is much like *E. sassacus* but the "brand" on the male is more like that of *H. phylæus.* lower side of the hind wings is more distinctly banded


Epargyreus tityrus
larva and nest
Thorybes bathyllus
Thanaos juvenalis
Erynnis sassacus
Hesperia tessellata
Ancyloxypha numitor
Hylephila phylaeus
pocohontas
♀
♂
Polites coras
Atrytone hobomok
♂
Catia druryi egeremet

spotted than in *sassacus*. It is often caught with this species but is abundant later in the season.

*Atrytone hobomok*. The variety *pocahontas* is always female; the light markings are cream-color. Larva on grasses.

### Megathyminæ

*Megathymus* is a genus in which the adults are stout bodied and have a wing expanse of about three inches. Their larvæ bore in the pith of *Yucca*. This genus has been variously placed and at one time was considered to belong with the moths.

## HETEROCERA

See p. 115 for some of the distinctive characteristics of Moths.

### Sphingidæ

These trim creatures are, for the most part, called Hawk Moths from their strong flight, but some are called Humming-bird Moths. Although strong of flight, the wings, especially the hind ones, are small in comparison with the body, which is usually stout and tapered at the hind end. The larvæ are hairless, except when very young, and usually have a horn (absolutely harmless) at the hind end of the body; in some species, especially when the larvæ are full-grown, this horn is reduced to a tubercle and in some it is entirely absent. The name of the family and its English translation, "Sphinx," comes from the more or less sphinx-like attitude of the larvæ when at rest with their front segments elevated and the head drawn in. Pupation takes place in or on the ground and some pupæ have a "handle" which is really a sheath for their long tongue. As far as I know, all the adults feed and, with a few exceptions, all are crepuscular. When at rest, their long tongues are tightly curled up under their head like a watch spring. There are many species, but they are difficult to characterize in few words and I must regretfully refer the reader to more special books, such as Holland's *Moth Book*, for the identification of the majority.

**Hemaris**

The adults of this genus of Humming-bird Moths, which is also called *Hæmorrhagia* and which belongs to the subfamily Macroglossinæ, have wings from which part of the scales rub off so easily that they are almost never seen and those portions of the wings are, therefore, described as transparent. These adults have the unmothlike habit of flying freely in the bright sunlight and, when hovering at flowers, they closely resemble humming-birds. Plate XXXVIII shows the typical (summer) form of the northern race of *thysbe*. The spring form, *cimbiciformis*, differs, among other ways, in having the outer margin of the transparent areas an even line. There are also two seasonal forms of the southern race. *Hemaris diffinis* is smaller than *thysbe* and has the dark areas on the abdomen black instead of reddish. When flying, it suggests a bumblebee. The thorax of *Hemaris gracilis* is greener, in life, than *thysbe* and has a pair of reddish, longitudinal lines on the under side of its thorax. All three are eastern species, *gracilis* being confined to the Atlantic States and usually not as common as the others. Their larvæ feed on relatives of the honeysuckle, such as snowberry (*Symphoricarpos*) and *Viburnum*. They usually pupate in fallen leaves and generally make a poor sort of a cocoon. The pupæ do not have free tongue-cases.

## Chœrocampinæ

*Amphion nessus* flies about twilight, and earlier, in May and June. It has a wing-expanse of two inches, or more, but its body is only about an inch long; its general color consists of various shades of brown; there is a narrow, yellowish-white band across the abdomen; the hind wings have reddish centers and yellowish-white front margins; the outer edge of each front wing has two marked indentations. The larva feeds on grape, Virginia creeper, and other plants; it has a short, rough tail-horn, a brown body-color with black and yellow dottings, and the third and fourth segments somewhat enlarged. It pupates in fallen leaves, usually spinning a few threads.

*Sphecodina abbotii* has a wavy outer margin of the front wings similar to that of *nessus* but, among other differences, the basal half or two-thirds of the hind wings is yellow. It flies, as a rule, just after sunset. The larvæ, which feed on grape and Virginia creeper, have two color forms, green and brown; they have an eye-like tubercle instead of an anal horn. Even more than most of their relatives, they thrash their tails about. Eliot and Soule say: "We have seen orioles try to pick up an *abbotii* larva on our woodbine, and dart away with a scream when it lifted its snake-like anal end with the tubercle shining like an eye. The caterpillars make a squeaking noise; how they make it we do not know." Other Sphingid larvæ make a similar noise. The tongue-case is not free.

**Deilephila lineata**

The adults of this common Striped Sphinx (Plate XXXVIII) may be found flying at, apparently, any hour of the day or night from July to November. *Celerio* is sometimes used for the generic name. "When full-grown the caterpillars are three inches long and vary greatly in coloring and markings. There seem to be two styles of dress; one is yellowish green with a series of connected spots along each side of the back, each spot being colored crimson, yellow, and black; the other dress is black, with a yellow line down the middle of the back, and yellow spots of various sizes along the sides. These two styles may be varied in many ways" (Dickerson). There is a distinct anal horn. Although it is sometimes called the Purslane Sphinx, the larvæ feed on a great variety of plants including apple, grape, Virginia creeper, and currant. It is sometimes injurious to cultivated plants but it has never hurt "pursley" enough to suit me. Sometimes they make a loose, open cocoon at the surface of the ground, but usually they go just below the surface and spin no threads. The tongue-case is not free.

*Deilephila intermedia* is much like *lineata* except that it has only two pairs of dark marks on its abdomen and the veins of the front wings are not marked with whitish. It is not usually common but it ranges from Canada to

Deilephila
lineata
Hemaris
thysbe
Ampelophagus myron
Pholus pandorus

Mexico, and a nearly related species is found in the Eastern Hemisphere. The larva feeds on grape, *Epilobium*, and other plants.

**Pholus pandorus**

This (Plate XXXVIII) may be but a form of *satellitia*. It flies at dusk, and later, from June to November. The larva, which feeds on grape and Virginia creeper, is green, when young, and has a long horn, which often curls over its back; but the full-grown larvæ are tailless and usually brown. The pupa, with adhering tongue-case, is usually formed underground. It is a widely distributed species with several local races.

*Pholus achemon* has a brown general color, the basal three-fourths of the hind wings are pink, and the dark markings on the hind margin of each front wing are reduced to a rectangular spot near the middle and a smaller, triangular spot near the outer end. Larval and pupal habits like those of *pandorus*.

**Ampelophagus myron**

For some reason, or none, this species is called Hog Sphinx. Plate XXXVIII shows a larva bearing on its back the cocoons of an Ichneumonid whose larvæ had been feeding on the tissues of the moth's larvæ. Such cocoons may be found on many kinds of caterpillars but this species is much afflicted by the parasites. The principal food plants of *myron* are grape and Virginia creeper. A cocoon is made among fallen leaves.

*A. pholus* is much like *myron* but the front wings are brownish. Its larva feeds on *Virbunum* and *Azalea*. There are two annual broods.

*A. versicolor* differs from *myron* in having a white median-dorsal line and, on the thorax, a pair of white side lines, white markings on the green front wings and a broad, whitish hind-margin of the hind wings. The larvæ feed on *Hydrangea*, *Decodon*, and buttonball (*Cephalanthus*).

## Sphinginæ

**Phlegethontius carolina and celeus**

A name commonly used for this genus is *Protoparce; carolina* (Plate XXXIX) was called *sexta* because of the six orange-yellow spots on each side of the adult's abdomen, and *celeus* was called *quinque-maculatus* because it has five such spots. The general color of the adult *carolina* is grayish brown; *celeus* is much lighter and, among other differences, the dark lines corresponding to the two outer ones on the hind wings of *carolina* are fused to form a band and the three inner lines are distinctly zigzagged. The mature larva of *celeus* may be distinguished from that of *carolina* by the fact that the lower ends of the light markings on the side of the abdomen curve backward below the spiracles (breathing holes). In the South the pupæ are sometimes called "hornblowers" because the free tongue-case suggests a wind instrument. The larvæ are called Tobacco Worms or Tomato Worms, according to the crop on which they are found. They also eat the leaves of potato and other Solanaceæ.

## Smerinthinæ

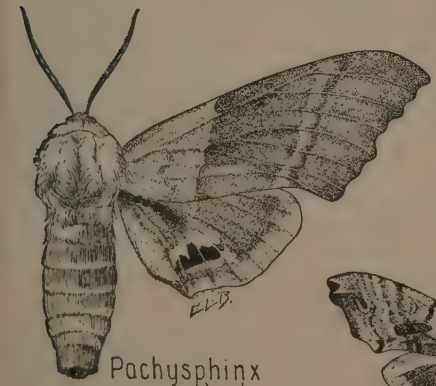
**Pachysphinx modesta**

The Modest Sphinx is not usually common but, when seen, always attracts attention. The shaded portions of the wings (Plate XXXIX) are brown, tinged, on the hind wings, with pink; the dark spot near the angle of each hind wing is purplish black. A western form, *occidentalis*, has whitish front wings and largely pink hind wings. The larvæ feed on poplars and willows, pupating in the ground. Some authors place this species in the Oriental genus *Marumba*.

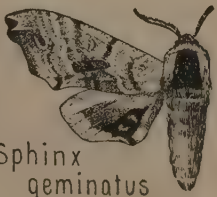
**Sphinx jamaicensis geminatus**

Holland explains the scientific name of the Twin-spot Sphinx as follows: "This beautiful hawk moth was originally named and described in error by Drury as coming from the Island of Jamaica. He also was so unfortunate as to have had for his type an aberrant specimen in which the ocellus of the hind wing had but one blue spot. Such

Phlegethontius carolina



Pachysphinx modesta



Sphinx geminatus

specimens now and then occur, and have been obtained by breeding from the normal form, to which Say gave the name *geminatus*. Specimens also sometimes occur in which there are three blue spots in the ocellus, and Mr. Grote gave to this aberrant form the name *tripartitus*." The ground-color of the wings is light gray but the eye-spots (Plate XXXIX) are set in a pink area; the thorax and front wings are marked with rich brown. The larvæ are bluish green with yellowish white lines and granules; the horn is usually blue but sometimes greenish or even pink. They feed on willows, poplars, birches, and wild cherry. The tongue-case of the pupa is not free. Adults fly from May to August.

*Sphinx cerisyi* has a wing-expanse of about four inches and the single ocellus on each hind wing consists of a dark spot surrounded by, first, a light ring and, then, a dark one. Its larva feeds on willow.

Adults of *Calasymbolus* (also called *Paonis*) have, on each hind wing, a light dot surrounded by a dark ring. The size and outline of the wings of *C. myops* are almost exactly those of *S. geminatus* but the general color of the front wings is brown and the eye-spots of the hind wings are set in a yellow area. Larvæ on wild and cultivated cherry. *C. astylus* is about like *myops* in size and general color but the outline of the wings is more even and the front wings have a white streak parallel to their outer margins. Larvæ on huckleberry and dangleberry. *C. excæcatus* is somewhat larger than *geminatus* and it has a similar pinkish area on the hind wings but the general color is browner and the outer margins of the front wings are saw-toothed, six or eight teeth to each. Larvæ on Rosaceæ and a large number of other trees.

Sphingid larvæ are so easily recognized as being Sphingids that the following additional notes may be helpful but it should be said that larvæ often eat other sorts of leaves also. Larvæ of *Theretra* (*Chærocampa*) *tersa* feed on *Bouvardia* and buttonwood. *Dilophonota ello*, on *Euphorbia*. *Phlegethontius* (*Protoparce*) *rustica* on *Chionanthus* and *Jasminium; P. cingulata*, on morning-glory and

sweet-potato. *Hyloicus* (*Sphinx*) *kalmiæ*, on laurel, lilac, ash, and *Chionanthus; H. drupiferarum*, on plum and wild cherry; *H. gordius*, on huckleberry, bayberry, and birch; *H. luscitiosa*, on willow; *H. chersis*, on lilac and ash; *H. eremitus*, on pepper, wild bergamot, and *Salvia; H. plebeius*, on trumpet vine and Passiflora. *Dolba hylæus* larvæ are said to complete their growth in twenty days on black alder and sweet fern. *Chlænogramma jasminearum*, on ash. Larvæ of *Ceratomia amyntor* have four short thoracic horns in addition to the anal one and feed chiefly on elm; the black and yellow larvæ of *C. catalpæ* feed on *Catalpa*. *Lapara bombycoides* and *coniferarum*, on pines. *Cressonia juglandis*, on hickory, walnut, ironwood, and wild cherry.

### Saturniidæ

These Giant Silk-worm Moths are the amateur's delight because of their large size, beautiful colors, and often conspicuous cocoons. The antennæ of the males are feathered to their tips and are always larger than those of the female; the mouth-parts of the adults are poorly developed and apparently functionless but the huge larvæ are certainly hearty feeders and, fortunately, have many enemies; whoever tries to raise Saturnid adults from wild cocoons is almost sure to get more parasites than moths.

**Philosamia cynthia**

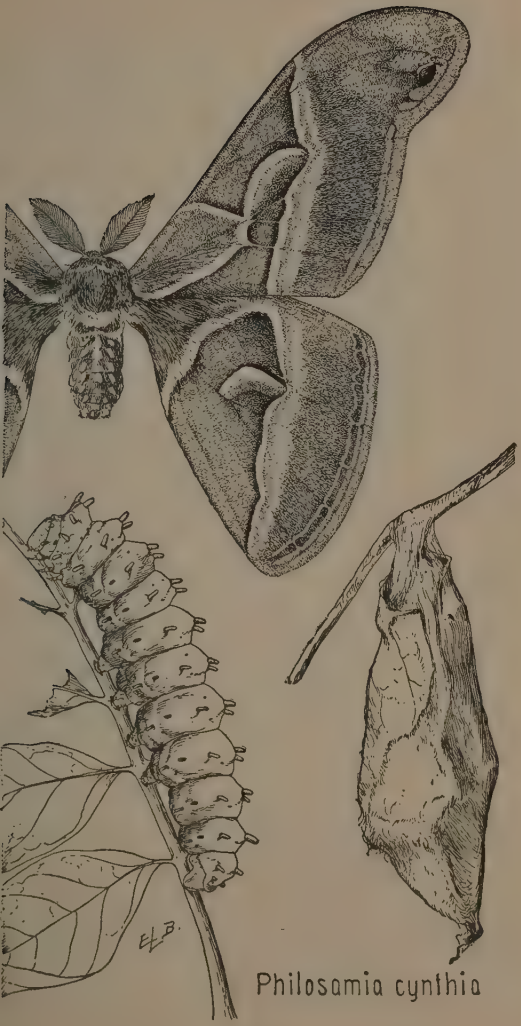
The Asiatic Ailanthus Silk-moth (Plate XL) was brought to America about 1861, presumably in the hope that silk from its cocoon might be used commercially. That hope has not yet been realized and the larvæ occasionally occur in large enough numbers to be injurious to ailanthus trees—their original and favorite leaf, although they also feed upon wild cherry, linden, sycamore, lilac, and other plants. The full-grown larva is green with black dots; the tubercles are pale to quite blue except that those of the lowest (substigmatal) row are banded with black; the head, legs, props, and anal shield are yellow except for blue markings on the last two; spiracles (or "stigmata," the row of breathing holes along the sides) are black with a

white dot at each end. The larvæ eat their cast skins. The cocoon is spun on a leaf which has first been fastened to the branch with silk, the pupa hibernating. Hanging cocoons like this are hard for birds to peck. The adults may be recognized by the white tufts on their abdomen. Distributed locally (especially near cities) along the Atlantic Coast.

*Rothschildia*, with two species, *orizaba* and *jorulla*, in Arizona, may be recognized by the triangular shape of the translucent spots of the fore and hind wings.

**Samia cecropia**

The Saturnids are indeed fortunate moths; they have largely escaped successful "English" christenings. Although this species (Plate XLI) was named *cecropia* by Linnæus long ago and has been a common and popular moth in this country ever since moths were at all popular, Cecropia is still its common name. I hope my children's children will call it Cecropia even though it has been recently nicknamed something else by a lady who writes very good fiction but who has done immeasurable harm to unalloyed love of nature by encouraging the commercial viewpoint. People forget that the Limberlost stories are fiction, and my mail has been filled with letters from people, ranging all the way from an eight-year-old boy, who wanted to sell a battered Luna so that he could get a pony, to invalids, who wished to find a market for the moths which came to their bedside lamps so that they might buy medicine. Permit me to say that he who goes to Nature with money in his eyes will not only be blind to her truths, her glories, and the real benefits which she offers to those who love her, but he will be disappointed as to his financial returns. The "market" value of even our rare insects is so small that, unless you have the requisite knowledge and can give your entire time to collecting, classifying the spoils, and finding the particular markets for the particular sorts, you will not usually be paid for shoe-leather. But to return to more pleasant things: Cecropia's head, body, and bases of the fore wings are a rich red except for the white bands; the general wing-color is dusky reddish brown;



Philosamia cynthia

the crescents on the wings vary from white (especially on the hind wings) to reddish and are bordered with red and black; outside the prominent white band there is a reddish band (in *S. gloveri* of the West this band is broader and purplish gray although inside of the white band the wings are red); the outer border of both pairs of wings is light clay-brown. *S. columbia* occurs in northern United States (west to Wisconsin) and in Canada; it has a wing expanse of only about four inches and no red margin to the white cross band. *S. rubra* of Utah and Wyoming westward is about the size of *columbia* but the general wing color is rather uniformly light red; it lacks, as does also *gloveri*, the round dark areas near the hind angles of the fore wings. The larva of *cecropia* is about four inches long; green with bluish tints, especially along the back, two rows of blue tubercles along each side, two rows of yellow ones along the back, and two pairs of red ones on the thorax. The large cocoons, which when cut open have distinctly the appearance on one cocoon inside another, are fastened to a branch, or other support, but not to leaves. Some cocoons are much larger and puffier than others, probably because the larvæ which made them were better fed. This species ranges from the Atlantic to the Great Plains.

**Callosamia promethea**

I am sorry that such an authority as Holland should have called this species (Plate XLII) the Spice-bush Silk-moth when "Promethea" was already in common usage; furthermore he says, truly, that "The insects subsist in the larval stage upon a great variety of deciduous shrubs and trees, showing a special predilection for *Lauraceæ*, *Liriodendron*, *Liquidambar*, and wild-cherry" (spice-bush and sassafras belong to the family Lauraceæ). The mature larva is from two to three inches long; head, yellowish-green; body, "frosted" bluish-green; six rows of small black tubercles; two pairs of red tubercles on the thorax; one yellow tubercle on the eleventh segment; the legs and the anal shield yellow. The cocoon is much like that of *cynthia* but tends to be darker and slimmer and is not so likely to have silk strands over the leaf. The general color of the

Samia cecropia

male's wings is such a dark maroon that it is sometimes practically black and all but the marginal markings are obscured; the female is much lighter colored.

Both sexes of *C. angulifera* have a fat, V-shaped, white mark, something like that on the hind wings of the female *promethea*, on the front wings, and the female has it on the hind wings also. Its larva feeds chiefly on the tulip-tree (*Liriodendron*). The cocoon is wrapped in leaves like Promethea's but with the difference that usually no "stem" fastening it to the twig is made so that the cocoon falls to the ground when the tree sheds its leaves. It is an Atlantic Coast species which is usually not common even in the Middle States, its principal home.

The Saturnid moths thus far mentioned belong to the subfamily Attacinæ. We now take up the Saturniinæ.

**Actias luna**

The Luna Moth (Plate XLIII) is rather generally considered to be our most beautiful insect but its lovely green fades rapidly to a light gray. It is rather common and, once seen, is rarely forgotten. The larva feeds on walnut, hickory, sweet-gum (*Liquidambar*), persimmon, and other trees; when mature, it is about three inches long; it varies somewhat in its colors, especially those of the tubercles; and suggests the larva of *polyphemus* but may be distinguished from it by the yellow lateral line and the absence of the seven oblique side-stripes; when about to pupate, the back usually changes from yellowish green to pinkish. The cocoon is very thin and rattles when pressed or when the pupa moves; it is usually made between leaves on the ground. In some sections it is at least double-brooded. The early-spring adults usually have purple outer margins on the wings; later individuals lack these.

**Telea polyphemus**

Larvæ of Polyphemus (Plate XLIV) are sent in to the American Museum every season so that they must be frequently seen by the "laity" even though they are the color of leaves. They feed on oak, birch, and a great variety of other trees, and somewhat resemble those of *luna*. More

Callosamia promethea

than their relatives, *polyphemus* larvæ have the habit of elevating the front part of their bodies and pulling in their heads to assume a "terrifying attitude"; clicking their jaws probably adds to the effect. Many books say that the cocoon falls to the ground in the autumn (there is but one annual generation) but this is by no means always the case. The cocoon, which is more solid than Luna's, contains a long, unbroken, easily unreeled thread of silk which would be commercially valuable if labor were cheaper. The wings are ochre, usually pinkish, and each has a transparent spot, those on the hind wings being bordered inwardly by blue and set in a black ring.

**Automeris io**

The larvæ of the Io Moth (Plate XLV) should be handled carefully since their spines are sharp and are connected with glands which secrete an irritating fluid. They feed on a great variety of plants, including corn, and, when young, "follow the leader," spinning a silken path for the guidance of those which are behind. The larva is easily recognized, especially on account of the red (upper) and white (lower) longitudinal stripes on the sides of the abdomen. The thin, semitransparent, brown cocoon is spun among leaves on the ground. There are several other species which may be recognized as *Automeris* from their general resemblance to *io;* another generic name is *Hyperchiria.*

## Ceratocampidæ

The adults have mouth parts but probably do not feed. Pupation occurs in the ground, no cocoons being formed. Perhaps we should call this family Citheronidæ.

**Anisota**

The black and yellow (or orange) larvæ of *Anisota senatoria* (Plate XLVIII) feed on oak, often in large colonies. The adult female has a yellow body and brownish-yellow wings, largely free from dark dots and with a tendency toward violet at the margins of the front wings. The male is reddish brown and the central halves of the front wings are slightly translucent. The larva of *A. virginiensis*, on oak, is dark greenish,

Actias luna

Telea polyphemus

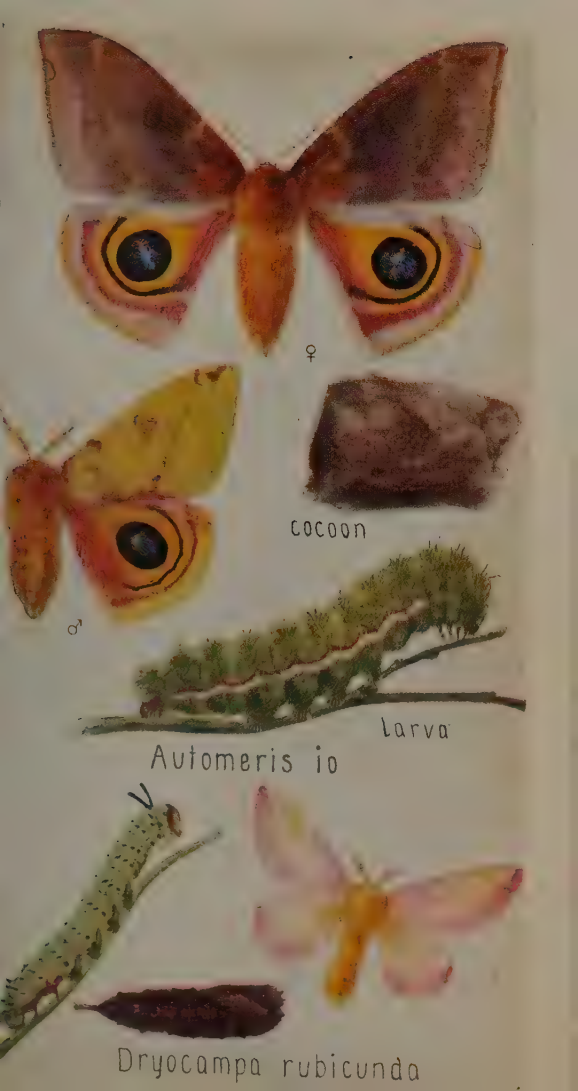
with two purplish red stripes and three rows of black spines on each side; it is covered with white granules and has a pair of long, black "lashes" on the second segment. The adult female is much like the female *senatoria* but is more thinly scaled and with a definite violet band along the outer margin of each front wing. The male (Plate XLVIII) is like the male *senatoria* but darker and the central areas of the front wings are transparent, with definite boundaries. The larva of *A. stigma*, on oak, chestnut, and hazel, is brown, dotted with white; it has a very narrow, dusky, mid-dorsal line and a wider one on each side along the spiracles; body spines longer than in the other species. The adult female is much like the female *senatoria* but with about half an inch greater wing expanse, is more heavily scaled, and with a tendency to have the front wings, at least, thickly dotted with black. The male is much like its own female, but smaller and with a tendency to violet along the outer margins of the front wings; the wings have no translucent areas. The chrysalids are all much alike.

**Dryocampa rubicunda**

The Rosy Maple-moth (Plate XLV) is sometimes, probably correctly, put in the genus *Anisota*. Its larva feeds on maple. The pupa is somewhat shiny; and the adult, though variable in color, may be known by being a fluffy combination of rose color and pale-yellow, often tinged with pink. It is most abundant in the Middle West but it is occasionally injurious from Mississippi to New York.

**Citheronia regalis**

Names applied to the adult and larva respectively, Royal Walnut-moth and Hickory Horned Devil, tell two of the food plants of this species (Plate XLVI); there are a variety of others, including butternut, ash, persimmon, sweet gum, and sumac. The horns of the mature larva are reddish, tipped with black, and are perfectly harmless. Perhaps the best short description of the adults is by Kellogg: "a rich brown ground-color on body and hind wings, with the fore wings slaty gray with yellow blotches, and veins broadly marked out in red-brown."




Automeris io

Dryocampa rubicunda

Citheronia regalis

The Pine-devil (*Citheronia sepulchralis*), which is said to range along the coast from Maine to Florida but which has never been reported from New Jersey, for example, is somewhat smaller than *regalis* and has uniformly brown wings.

**Basilona imperialis**

The hairy larvæ of the Imperial Moth (Plate XLVII) vary from green to very dark brown; their horns are proportionately larger in the younger stages. The female is rich canary-yellow marked with pinkish purple; the male has the same colors but the purple is darker and covers most of the fore wing. Food plants: a great variety of trees including hickory, oak, elm, maple, spruce, pine, junipers, and hemlock. Another generic name is *Eacles*.

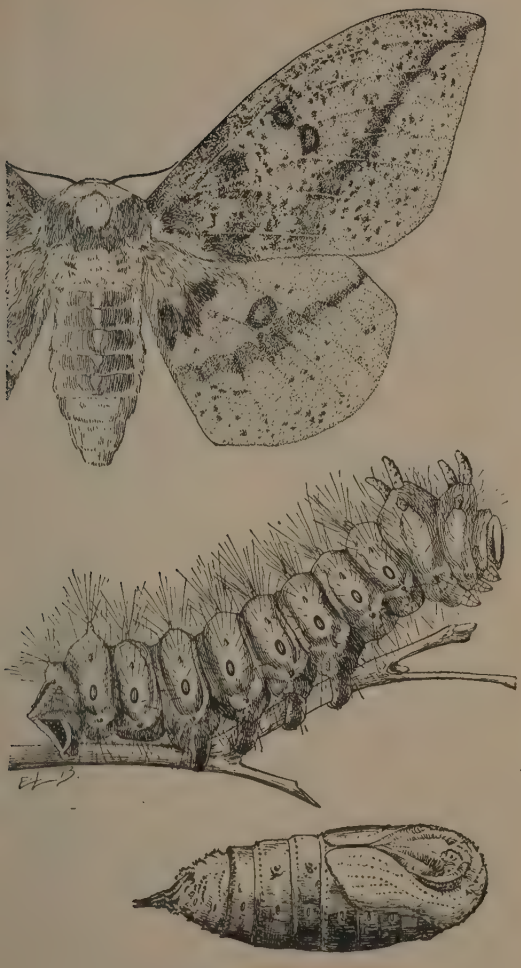
### Amatidæ

These largely southern moths are day-flyers and some of them much resemble Hymenoptera. The proboscis is usually, but not always, well developed so that they may feed. The family has also been called Syntomidæ. The cocoons are of felted hair.

*Lycomorpha pholus* (Plate XLVIII) may be recognized by the black and yellow markings. Its larva is said to feed on lichens. The adult is common on flowers and is found throughout the United States.

*Scepsis fulvicollis* (Plate XLVIII): the wings are brown, except for the transparent central part of the hind wings; the abdomen is metallic blue-black; and there is a yellow collar. The larvæ feed on grasses, and the adults frequent golden-rod flowers.

*Ctenucha virginica:* the adult, which has brown wings, metallic bluish-black body, and orange head, is found at the flowers of blackberries, Spiræa, and other plants in the Appalachian region. The larva feeds on grasses.



Basilona imperialis

### LITHOSIIDÆ

The larvæ of this family are hairy, somewhat after the fashion of the Arctiidæ. Cocoons, of silk and larval hairs, are made by some species but others are said to have naked pupæ. The adults have thread-like antennæ and, usually, well-developed mouth parts; they are popularly called Footman Moths.

*Hypoprepia fucosa* (Plate XLVIII) has three lead-colored stripes on the fore wings, the ground color being yellow and red. *H. miniata* is very much like it but the dark markings are darker, and the light portions are bright scarlet. The larvæ of both feed on lichens.

### ARCTIIDÆ

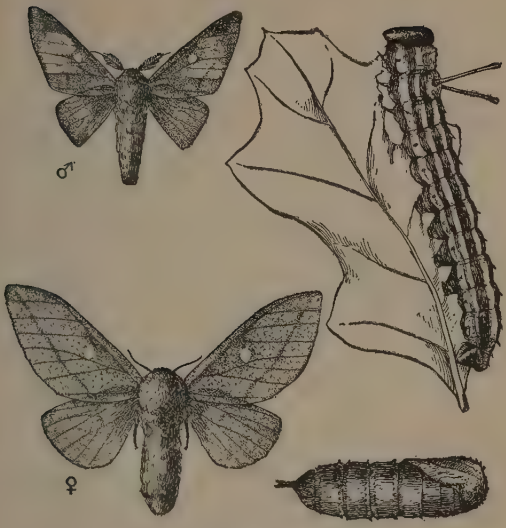
Topsell, in his *History of Serpents* (1608), said the larvæ of these moths were called Palmer-worms, by reason of their wandering and roguish life, although by reason of their roughness and ruggedness some call them Beare-wormes (modern: Woolly Bears). Keats referred to the adults when he wrote:

> "All diamonded with panes of quaint device,
> Innumerable of stains, and splendid dyes,
> As are the Tiger Moth's deep damask wings."

There are more than 2000 species. The larvæ are hairy, usually very much so. The cocoons are made of silk and larval hairs. The adults of some genera have aborted mouth parts; others have well-developed probosces.

**Utetheisa bella**

The color and markings of the Beautiful Utetheisa (Plate XLIX) vary greatly but there is nothing in its range (Quebec to Mexico and Antilles) which closely resembles it, except the southern *U. ornatrix* which has "washed-out" front wings. Although the adult sometimes comes to lights, it is easily flushed, in the daytime, by walking through the meadows in which its food plants grow. The larva is recorded as feeding on cherry, elm, and other plants, but I have found it only on and in the green seed-pods of *Crotalaria* (Rattle-box) and doubt if it feeds on anything but Legumes.




Anisota senatoria

A. virginiensis

Lycomorpha pholus

Scepsis fulvicollis

Hypoprepia fucosa

**Haploa**

Nature seems to make the Haploas, and other Arctids, by guess, they are so variable. Plate XLIX shows one of the more constant species, *H. clymene*. Species of this genus tend to have a dark band, more or less complete, running from the hind margin of each front wing to near its apex; these wings are often margined with dark color also but in some forms they are immaculate. The larvæ are classed as "general feeders" but more careful study will doubtless discover decided preferences.

**Estigmene acræa**

Plate XLIX shows the female; the male has yellow hind wings. The spotting varies greatly in both sexes, and there are a number of local races. The name, Salt-marsh Caterpillar, is misleading; as a matter of fact, the species is found throughout North America, the larva being a general feeder.

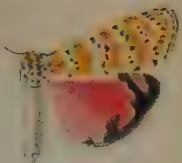
**Hyphantria cunea**

The unsightly nests, made in late summer, of the Fall Web-worm are frequently confused with the spring tents of *Malacosoma americana*. The nest of *cunea* has a lighter texture and covers all the leaves upon which the colony of larvæ are feeding; it occurs on more than a hundred different kinds of trees, apple and ash being among the favorites. The figures on Plate L indicate the great variability which exists in the markings of both larvæ and adults. The pupa, slightly protected by a loose cocoon, hibernates in crevices of bark, loose soil, etc. The eggs are laid in flat masses on the under side of leaves.

**Isia isabella**

The larva of this species (Plate XLIX) has caused much comment: Kellogg calls it "the woolliest woolly bear," and notes that "hedgehog" is a popular name; Holland connects the phrase "to caterpillar," in the sense of quickly yielding to unpleasant circumstances, with this species because, when disturbed, the larva curls up and lies motionless (a trick of the hedgehog, also); while Comstock recalls the "Hurrying along like a caterpillar in the fall" when speaking of the larva's apparent haste to find a snug place in

Haploa clymene



Utetheisa bella

Isia isabella

Estigmene acraea

Diacrisia virginica

Apantesis nais

Euchaetias egle

which to curl up for the winter. When spring comes, it hustles for a little food, plantain being a favorite, and then pupates in a cocoon made of silk and larval hairs. The relative amount of black in the larva's "fur" varies greatly and is said to foretell weather but I forget what is what, although some experiments which I once made indicated that past, not future, moist conditions increase the amount of black. There are two annual broods.

*Diacrisia* (also called *Spilosoma*) *virginica* is the Yellow-bear of our gardens; the dense, long hair of some individuals is, however, white and of others is reddish. The adults (Plate XLIX) have up to four small black dots on each of their white wings. One of the several broods hibernates in the pupal state.

*Apantesis:* There are twenty or more species in the United States alone. It is rather characteristic of the genus that the front wings are checkered somewhat after the fashion of the species, *nais*, shown in Plate XLIX; the prevailing colors are red, brown, and white. The larvæ are general feeders, especially on low-growing things, such as plantain.

**Euchætias egle**

Numbers of the gay Harlequin caterpillars (Plate XLIX) are frequently seen on milkweed, feeding together in apparent disregard of birds. Most birds do not seem to care for hairy larvæ at any rate, but probably this species gets additional protection, advertised by its colors, from the acrid nature of its food. The cocoon is formed under loose stones and leaves. One brood of adults flies in June, another in late summer. It and the following species are given, by some authors, the generic name *Cycnia*.

*Pareuchætes* (or *Ammalo*) *eglenensis* also feeds on milkweed. The predominating color of the larval hairs is dark gray; its head is orange, while that of *egle* is black. The adult resembles *egle* but is somewhat smaller and has the front margin of the front wings, the head, and the collar, orange. There is a summer form (*inopinatus*) in which the gray portions are almost white.

**Halisidota caryæ**

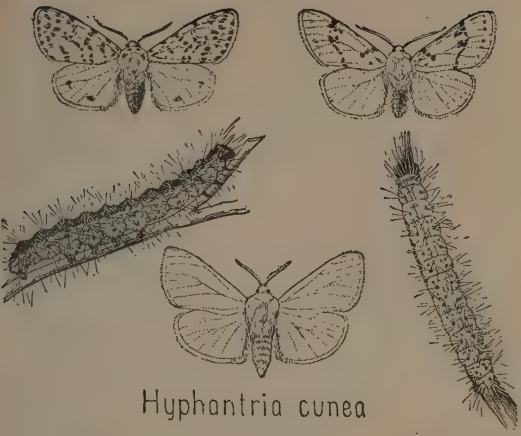
"The Hickory Tiger" is one of the English names of this species (Plate L) and, like the specific name, refers to the larva's fondness for hickory leaves but, as a matter of fact, it feeds on other trees also. It has also been called Tussock Moth, but that name should be reserved for a species of Liparidæ whose larvæ these resemble. The cocoon, which is made in some sheltered nook, is composed of larval hairs pushed through a very thin envelope of silk. The author of *Insect Lives; or Born in Prison* quaintly describes the color of the moths as being the same as that of hickory-nut meat.

*Halisidota tessellaris* is much like *caryæ* but the larva has no "black buttons down the back" and its body hairs are usually tinged with yellow or brownish; the adult *tessellaris* is much paler, being pale straw-color, and has bluish-green lines on the thorax. The larva is sometimes too common in our gardens and on shade trees. That description of the adult also fits the southern *cinctipes*, which is larger and has the lower part of its legs gartered with black. The western *argentata* has the white spots silvery and the ground color of the front wings dark brown. The adult of the northern *maculata* might be loosely described as like *caryæ* except that the white spots are dark spots.

## Agaristidæ

**Alypia octomaculata**

Members of the genus *Alypia* are called Foresters; translating the specific name, this species (Plate L) is called the Eight-spotted Forester. Its larva, which feeds on the leaves of grapes and of the Virginia creeper, is orange, yellow, black, and white; it has a hump near its tail. Pupation occurs in a very thin cocoon of chips and silk at, or slightly below, the surface of the ground; or the larva may gnaw into wood to pupate. The velvety-black adult has yellow spots on the front wings, white on the hind. It frequently flies by day. Although the Eight-spot is confined to the northeastern quarter of the United States, other sections have similar species.



Hyphantria cunea

Halisidota caryæ

Alypia octomaculata

## Noctuidæ

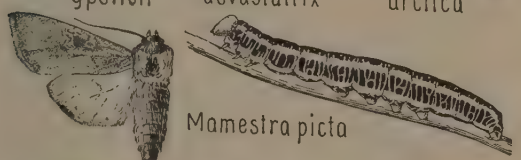
We have about 2000 species of this family in the United States. "Quite two thousand too many," most farmers and gardeners would say, because Cut-worms are young Noctuids; but not all young Noctuids are cut-worms. Noctua is the Latin for "owl"; these moths fly by night, and some have shiny eyes; we sometimes call them Owlet-moths. They come abundantly to lights and some species crowd "sugar bait," sipping the sweets. Like the adults, the larvæ, as a rule, feed by night. Those which are cut-worms are naked and hide by day just under the surface of loose earth or beneath stones and other shelters. They may be distinguished from "White-grubs," larvæ of beetles which have somewhat similar habits, by the fact that they have fleshy prop-legs on their abdomen. Cut-worms curl up, head to tail, when at rest or when disturbed. When very abundant, they clamber over plants eating the leaves, but their common name is derived from their habit of gnawing through the stems of tender annuals. Many cut-worms hibernate in snug underground cells and, so, are ready vigorously to attack our seedlings in the spring. Many other Noctuidæ, especially those whose larvæ feed on trees, hibernate as pupæ. Cut-worms may be controlled by turning over the soil in the late fall and early spring; but, better, they may be poisoned by distributing throughout the garden, before setting the seedlings, a mash made as follows: 1 part by weight of Paris green, 25 parts of bran, moistened with molasses diluted to half- or quarter-strength with water. Chickens invading the garden will be killed by this mash. Some of the destructive species of garden cut-worms which will not be further mentioned here are (Plate LI) *Agrotis ypsilon*, *Euxoa messoria*, *Peridroma saucia*, *Mamestra picta*, *Rhynchagrotis anchoceloides*, *Noctua clandestina*, and *N. c.-nigrum*. *Xylina antennata* (Plate LII) feeds on apple and other plants; the adult hibernates.

**Acronycta**

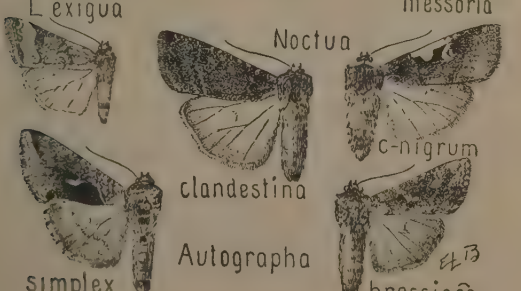
This genus is called *Apatela* in some books, and, commonly, Dagger-moths. As more than forty species have been recorded from

Acronycta americana

Agrotis ypsilon
Hadena devastatrix
arctica


Mamestra picta

Laphygma frugiperda
Rhynchagrotis anchocelοides
Euxoa messoria
L exigua


Noctua
c-nigrum
clandestina
Autographa
simplex
brassicae

New Jersey alone, I can do no more than give samples. *Acronycta americana* (Plate LI) is one of our largest species; the light-gray front wings expanding nearly 2.5 inches; the hind wings are brownish. With sufficient imagination, you can see, near the hind, outer angle of the front wings of *americana* and some other species, the "dagger" which is responsible for the common name of the genus. *Americana's* larva is one of the hairiest of Noctuid larvæ; with its dense, pale-yellow hairs it resembles an Arctiid but the hairs are scattered over the body instead of being grouped on tubercles as is the rule among the Arctiidæ; there is a pair of long, black hair-pencils on the first abdominal segment, another pair on the third, and a single such pencil on the eighth abdominal segment; in addition, there are hairs, longer than the general covering, along the sides and at each end. It feeds on maple (its favorite), elm, oak, and other forest trees. Larvæ of this genus often rest near the base of a leaf with the front end of the body curved back so that they are somewhat fish-hook-shaped. When disturbed, *Acronycta* larvæ are given to curling up and dropping off of their food plant. They pupate in loose cocoons, which are placed on rough bark or under ground-debris.

*Acronycta hastulifera*, according to its specific name, "bears a spear" instead of a dagger. Its larvæ are often abundant on alder and have been recorded on maple; they suggest those of *americana* but their color varies from pale to deep chocolate-brown. Eliot and Soule, whose *Caterpillars and their Moths* is not only a model of careful work but also shows what pleasure and profit ladies may get from a "crawlery," point out that these larvæ "are subject to fungoid diseases which kill many of them, and their stiff bodies may be found on branches of the alders, apparently unharmed, but they break at a touch and are filled with fungoid growth." As a matter of fact, fungi and bacteria vie with insect parasites as enemies of caterpillars in general.

The larva of *Acronycta hamamelis*, as its specific name signifies, feeds on witch-hazel but it is also found on various forest trees. This larva differs from its two relatives, just mentioned, in being almost hairless; it varies

from light yellow to reddish brown and has a double row of white spots on its back; these, its food plants, and its fish-hook resting position will usually identify it.

**Hadena**

This large genus contains two common, wide-spread, destructive cut-worms which are sometimes put in the genus *Xylophasia: devastatrix* and *arctica* (Plate LI). The larvæ attack garden and field crops; the adults have dark brown front and light hind wings. The larvæ of *Hadena turbulenta* are sometimes noticed on green briar (*Smilax*) because of their gregarious habits.

**Laphygma frugiperda**

The Fall Army-worm (Plate LI) appears later than the true Army-worm (*Leucania unipuncta*) and the larvæ are not so choice about their food for they eat almost any crop, scattering more than do the Army-worms. The pitch-black stripe along each side and the four black spots on the back of each segment distinguish this "worm" from *Leucania*. The naked pupæ hibernate about half an inch below ground. Adults emerge in the spring and the female covers her egg-clusters, placed on grass, with hairs from her own body. There are two or three generations a year but the larvæ which appear in late summer are the most destructive. The adult has a "general yellowish, ash-gray color, with the second pair of wings almost transparent, but with a purplish reflection." In the West there is a related species, *L. exigua* (Plate LI), which is called the Beet Army Worm because of its ravages among the sugar-beets.

**Leucania unipuncta**

The Army-worm (Plate LII), which is given the generic name *Heliophila* by some authors, is interesting for several reasons; for one, it is a conspicuous example of a species which occasionally gets ahead of its insect parasites and other ills, increasing its numbers to such an extent that its larvæ eat all the available food, chiefly grasses, in a given place and are forced to move *en masse*. However, fate is not to be permanently outdone and soon there comes a time when the species is relatively rare; and then again the

pendulum swings—Nature is "balanced" but not ve steady. This dull-brown moth gets its specific name fro the "one point" of white on each front wing. It appea early in the season (June in the North), and yellowi eggs are laid in rows at the bases of grass leaves, ea female depositing, all told, about seven hundred. T larvæ are nearly, or quite, two inches long when fu grown; they are grayish-black with three longitudin yellow stripes on the back, the median one being t narrowest, and a wide greenish-yellow stripe on ea side. They feed at night, hiding by day at the gra roots, and about mid-summer pupate, without a cocoo just under the surface of the ground. Adults emerge abo two weeks later but their offspring are not usually numero enough to be very destructive. The next brood of adu either hibernate or they lay eggs the same season and t larvæ hatching from these eggs hibernate. The number annual generations in the South is sometimes as high six. Army-worms with white eggs on them should n be killed, as these are the eggs of some parasite, usual of a Tachinid fly. There are numerous other species the genus, the Wheat-head Army-worm, *Leucania albilin* (Plate LII) being sometimes troublesome to farmers.

**Papaipema**

Larvæ of this genus, which has also be called *Hydræcia*, bore in the stalks plants. *Papaipema nitela* (Plate LII) is the best know for its larvæ are sometimes abundant in garden plan such as potatoes, tomatoes, and corn, especially if ra weeds, dock, and other wild plants, the natural food the species, are allowed to grow near the garden. Eg are laid in the fall but do not hatch until May. T larvæ then start tunnelling and if they confined themselv to one plant, not much injury would be done. Howeve they frequently leave the first plant and migrate so distance; it is then that our garden plants fall victim Infested plants wilt above the place where the larva working, but sometimes the larvæ get under the husks green corn and remain unnoticed until an attempt made to use the corn. However, see *Heliothis*. Pupati takes place in the larva's tunnel; no cocoon is made bu

Leucania unipuncta
Leucania albilinea
Heliothis armiger
Alabama argillacea
Papaipema nitela
Xylina antennata

just before it pupates, the larva bores a hole in the stalk so that the adult may easily escape. Adults emerge about August, there being but one annual generation.

**Heliothis armiger**

Sanderson, in his *Insect Pests of Farm, Garden, and Orchard*, and others use the specific name *obsoleta* for this species (Plate LII). Holland remarks: "This insect, which is known to English entomologists as the 'Scarce Bordered Straw,' is unfortunately not scarce in the United States, and, being of a singularly gluttonous habit in the larval stage, has become the object of execration to farmers and horticulturists." It has been called the Corn Ear-worm, Tomato Fruit-worm, Tobacco Bud-worm, and Cotton Boll-worm, in reference to some of its various food habits. The color and markings of the adults are variable, some being yellowish white, with nearly no markings, while others are dull green. The larvæ are also variable: light green, reddish brown, or almost black; spotted, striped, or plain. Pupation occurs at the bottom of an underground cell which is like a half-U, the upper end being near the surface of the ground but not at the point where the larva entered; there is no cocoon. There are two annual generations in the North but there may be five or six along the Gulf. In the North, winter is usually passed as a pupa. When feeding on young corn, the larvæ eat the leaves but later they feed on the tender ears and sometimes do as much as $50,000,000 damage a year in this way. When feeding on tomatoes, they prefer the green or just ripening fruit. When feeding on tobacco, they are called the False Bud-worm to distinguish them from the True Bud-worm (*Chloridea virescens*); as such they eat not only the flower-stalks and seed-pods but also the precious leaves. Not finally but for the sake of stopping somewhere, they do about $20,000,000 damage, annually, to cotton by boring into the bolls. In the North, winter plowing kills many of the pupæ, and, in the South, cotton may be protected by sowing trap-crops of corn, but everywhere the best plan with this, as with other insect pests, is to send an S. O. S. to your State Entomologist or to the United States Department of Agriculture for special information and

help. It is for this, among other things, that you pay your taxes.

**Autographa**

This genus (Plate LI) is variously split into several. For example, the Celery Looper, *Autographa simplex* of Holland's book, will be found under *Plusia* in some books. Except for this hint (and it applies with equal force in the case of other genera) to those who might be confused when more than one book is used, it need not concern us further since the only species we can mention in any detail was, no later than yesterday, still in the *Autographa* pigeon-hole. If you find a brown Noctuid-looking moth with a wing expanse of 1.0 to 1.5 inches and with one, or more, not strictly circular, silver spots near the middle of each front wing, it is a fairly safe bet that it is either *Autographa* or closely related to it. Some of the species fly by day. The larvæ are called loopers or semi-loopers because they walk somewhat like measuring-worms (Geometridæ) on account of not having any prop-legs on the third and fourth abdominal segments. *Autographa brassicæ* is a close second to *Pieris rapæ* when it comes to injuring cabbage, cauliflower, and the like. The larva is colored much like the ordinary cabbage worm but has longitudinal white lines when young, and it loops. The cocoon is a thin transparent affair attached to the leaf on which the larva was feeding. There are two or more generations annually, winter probably being passed in the pupal state. This is a good place to say that many of the Noctuid moths have a tuft of scales on the thorax which does not show well when viewed from above.

**Catocala**

The genus Catocala shares the amateurs' "love" with the Saturniidæ and the Sphingidæ. Many of its species are pretty; they are interesting because they have bright colors on the hind wings, which are covered, when at rest, by the "protectively colored" front wings and are usually displayed only at night when they cannot be seen—at least, by our eyes. Plate LIII shows an exhibit in the American Museum illustrating the fact that, however conspicuous when flying in day-

time, Catocalinæ are concealed in plain sight when resting. I will not swear that I ever saw a live *relicta* so neatly placed on just the right spot of just the right tree, a birch, but it surely does require sharp eyes to see a resting Catocala or, for that matter, almost any moth when it is naturally resting. The adults of *Catocala* are sometimes called Under-wings because of the conspicuousness of these organs. He or she who "sugars" for moths will probably find varieties of those illustrated here, as well as totally different species, for they are fond of sweets and are sometimes numerous. The larvæ tend to be plump in the middle, tapering toward both ends. They pupate in flimsy cocoons, which are usually placed under debris on the ground. Winter is usually, at least, passed in the egg state.

Mrs. Stratton-Porter, in lamenting her lack of knowledge concerning the life-history of these moths, takes another whack at some of us: "Professional lepidopterists dismiss them with few words. One would-be authority disposes of the species with half a dozen lines. You can find at least a hundred Catocala reproduced from museum specimens and their habitat given, in the Holland *Moth Book*, but I fail to learn what I most desire to know: what these moths feed on; how late they live; how their eggs appear; where they are deposited; which is their caterpillar; what does it eat; and where and how does it pupate. . . . This will tend to bear out my contention that scientific works are not the help they should be to the Nature Lover." Lord bless you, Mrs. Porter! If Dr. Holland had put in all that (He couldn't have done it.) for each of the thousands of species his books help you and others to identify, he not only would have deprived you of the pleasure of finding out these things for yourself but most of the "others," at any rate, would not have been able to own the resulting tomes. It so happens that I have seen Mr. Beutenmüller's uncompleted monograph of *Catocala;* it tells most of the things known about American *Catocala*, less than you ask, and there are over six hundred pages of manuscript. Perhaps it will be noticed that I am saying little about eggs; I have to draw a line somewhere, and people have not often asked me about eggs. I hope

Catocala relicta

C. cara

C vidua

C. ultronia

I have told, in this little book, something about all the sorts of insects' eggs which have excited the curiosity of my unspecialized visitors and correspondents. Of course, my experience is limited; tomorrow, some one, not a specialist nor an advanced amateur, may ask a question which I have not been asked before and very possibly I will be unable to answer it.

*Catocala ultronia* (Plate LIII) is a variable species, several forms having been given distinctive names. The larvæ feed on plum, apple, and wild cherry leaves. The pupæ in their cocoons, which are formed in July under chips or dead leaves, are covered with a bluish, easily rubbed bloom. Adults fly from late July to October. Eggs are well hidden in crevices of the bark of their food-trees.

*Catocala cara* (Plate LIII) larvæ, on willow and poplar, have a purplish head streaked and spotted with pale testaceous; their bodies are light to dark clay or wood brown; on each side of the back is a smoky, longitudinal band and a wavy, broken one on each side along the spiracles; the dorsal warts are dull carmine or yellowish-brown; the underside is reddish, with a large black patch between each of the first three pairs of abdominal legs. Adults are to be found from July to September.

*Catocala relicta* (Plate LIII) larvæ feed on poplar and also, probably, willow and white birch; they are greenish-white, thickly spotted with yellowish-brown, the ninth and twelfth segments and the head being marked with black. The cocoon is rather thick and is usually made in fallen leaves, drawn together by the larva. Adults, of which there are several named forms, appear from July to September.

*Catocala vidua* (Plate LIII) larvæ eat walnut, butternut, hickory, and oak; they are pale lilac with stripes composed of black dots, giving a gray appearance; their heads are striped with dull lilac and white and have orange spots, above, with a black hair in the center of each. Pupation is said to occur in June; most of our adult specimens were caught in August and September.

Plate LIV shows *Catocala concumbens*, larva on willow and poplar; *C. grynea*, larva on apple and plum; and *C. amica*.

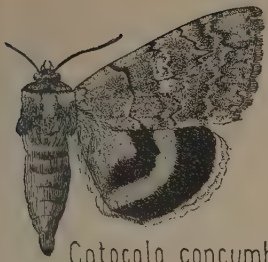
*Nubilis* (Plate LIV) has been put in *Euparthenos;* it feeds on locust.

**Alabama argillacea**

This species (Plate LII) claims a paragraph because it got into the New York subways, and also newspapers, last year. It belongs 'way down South in the cotton fields where, until the invasion of the boll weevil, it was Cotton's most serious pest. Its breeding range is from Argentina to as far north as cotton grows. The larvæ are greenish, variously spotted or striped with black according to their age. They feed on the cotton leaves, buds, and even tender twigs, pupating in a thin cocoon made in a folded leaf. Sanderson says: "The moth is a dull olive-gray color with a wing expanse of about 1⅜ inches, which sometimes has a purple luster and which are marked with darker lines. . . . Like most of the owlet moths it flies only after sunset, but unlike them it is not confined to the nectar of flowers for food, as its mouth is peculiarly adapted to piercing the skin of ripe fruit and feeding upon its juices." After stating that there are at least seven generations annually on the Gulf Coast and three at the northern limit of the species, he notes that "if none were killed, the progeny of a single moth after four generations would amount to over 300,000,000,000 individuals, or if placed end to end, the third generation would be enough to circle the earth at the equator over four times." That is a fairly good-sized "if," but make it much smaller and you still have a sufficient reason for a considerable northward migration.

**Erebus odora**

This large moth (Plate LIV) drifted into my Question Box because it was "big enough to be a Saturniid but isn't in the book"—one concerning the Saturniidæ, etc., of the vicinity of New York City. Size does not always count. This Noctuid does not belong in the North although, being a strong flier, it gets even into Canada. Holland records its having been found in a snow-storm at Leadville, Colorado. All the northern captures I know about were females in September. Although I have seen it flying

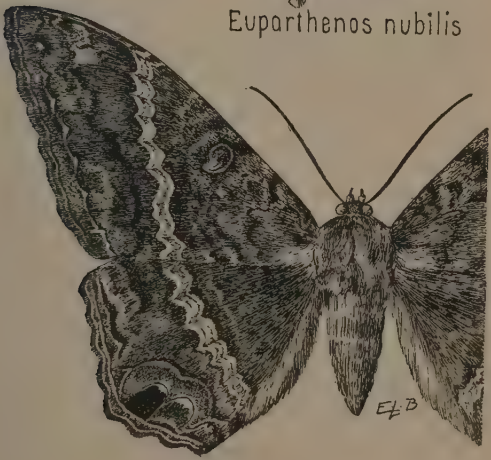


Catocala concumbens

C. grynea

C. amica

Euparthenos nubilis



Erebus odora

back and forth in its tropical home just at dusk or even at mid-day if the place was shady, I have never recognized its larva, which is said to feed on Legumes.

### Hypenidæ

These moths, or part of them, are sometimes put in the Noctuidæ. They are commonly called Deltoids because the outline of their wings, when at rest, is frequently triangular like the Greek capital Delta; also Snout-moths because the palpi of many species are enlarged and so held as to resemble a beak. For the most part, the adults are dull colored, obscurely marked, and not likely to arouse comment by any but the collectors, and even they have not been enthusiastic, although these moths come readily to light and sugar-bait. However, they have their interesting points. Secondary sexual modifications are common, the males frequently having wings, feet, antennæ, or palpi shaped differently from those of their mates. The larvæ of *Epizeuxis americalis* have been found in the nests of ants (*Formica rufa*); it and some of its relatives seem to prefer dead leaves to living. *Hypena humuli* is frequently injurious to hops. In July, Mr. Grossbeck found a swarm of adult *Epizeuxis lubricalis* (Plate LV) in a hollow tree. The larvæ feed on decaying wood and, probably, also on grasses; they are usually found under chips.

### Notodontidæ

The adults superficially resemble the Noctuidæ. They come freely to light and often to sugar-bait. The larvæ have no claspers at the hind end of the body and so they more generally wave this portion in the air than do other caterpillars; sometimes the anal segment has a pair of fleshy projections but these seem to correspond rather to humps on other segments than to prop-legs. The pupæ are usually naked.

**Datana** The yellow-necked, yellow-striped caterpillar on apple and other trees which seems, when disturbed or when at rest, to be trying to touch its

tail with its head is fairly certain to be *Datana ministra* (Plate LV). It is somewhat fuzzy, especially when young, and is given to associating with its brothers and sisters, the whole family gathering in a mass and going through their gymnastics at the same time. The naked pupæ winter in the earth. The adults emerge in June and July; their front wings are reddish brown, their hind wings pale yellowish. The eggs are laid in flat masses of about a hundred on the leaves of their food plants. The larvæ of *Datana integerrima* are darker than those of *ministra*, they lack the yellow neck-band, and they seem to have more fine white hair. They feed chiefly on walnut and hickory. The adults are browner (not so reddish) than *ministra* and the pair of fine lines which enclose a dark area near the base of the front wings do not diverge from each other so much. You may find *Datana angusii*, and other species as well, but the larvæ of all, as far as I know, throw themselves into the posture shown for *ministra*.

**Schizura**

The larva of *Schizura concinna* (Plate LV), which feeds on apple and other orchard trees as well as on rose, blackberry, and a great variety of plants, is frequently noticed because of the prominent bright red hump on the first abdominal segment; the head is also red; the body is black, striped with yellow. Holland, quoting Sir George Hampson, says the pupæ of Notodontidæ are naked; I put in a "usually," above, because I have it on good authority that the larvæ of this species become full grown in late summer or early fall and then spin loose silken cocoons to which are attached bits of earth and rubbish, so that they closely resemble their surroundings as they lie on the ground beneath rubbish, or just under the surface of the soil. After some time the larvæ transform to pupæ, in which stage the winter is passed. The adult has a wing expanse of about an inch and a quarter, gray front wings with a curved cross-row of brown shades near the middle, and white hind wings with dark vein-tips and a small dark spot at the hind angle.

## Liparidæ

**Hemerocampa leucostigma**

The best known and worst liked species of the family is the present one, which is popularly called the Vaporer or White-marked Tussock Moth. The latter name refers to the larva (Plate LV) with its four white tussocks. This larva is further adorned with three long pencils of black hair, a coral-red head and, in addition to yellow and black stripings on the body in general, two small red protuberances on the sixth and seventh abdominal segments; these red swellings are said to be organs which give off an odor disagreeable to the larva's enemies. All in all, it is a pretty creature if it only would not eat the leaves of our shade trees, among which it seems to be no respecter of species. I am not sure how the name Vaporer arose but I remember that my mother used to ask me not to "vapor" around her face when I got to swinging things about. Well, this larva is much given to spinning a long thread, hanging by it from a tree and allowing itself to be swung by the breezes. Perhaps that is the reason for the name. The grayish cocoon is placed on tree trunks, fence corners, and similar places; it is composed of larval hairs held together by silk. The adult female is a stay-at-home for she has no wings. She merely crawls to the outside of the cocoon, mates, lays her batch of four hundred or so eggs on the cocoon, protects them with a firm, frothy-looking covering, and dies. The general color of the male is ashy gray. There are from one to three generations a year, depending on the climate. It is the eggs which over-winter. Slingerland and Crosby note that the tussock-moth is beset with many enemies. After mentioning birds and predacious insects they say "as many as 90 per cent. of the caterpillars and pupæ sometimes fall a prey to more than twenty different kinds of hymenopterous and dipterous insect parasites. . . . Unfortunately, however, there are fourteen hyper-parasites which work on the true parasites and thus materially lessen their effectiveness. There are also tertiary parasites which destroy these hyper-parasites, thus presenting a very complicated and interesting case of insect parasitism." If you once get a

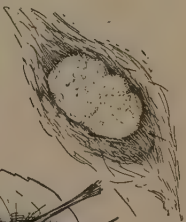
Epizeuxis lubricalis

Schizura concinna

Datana ministra

♂

♀



E.L.B.

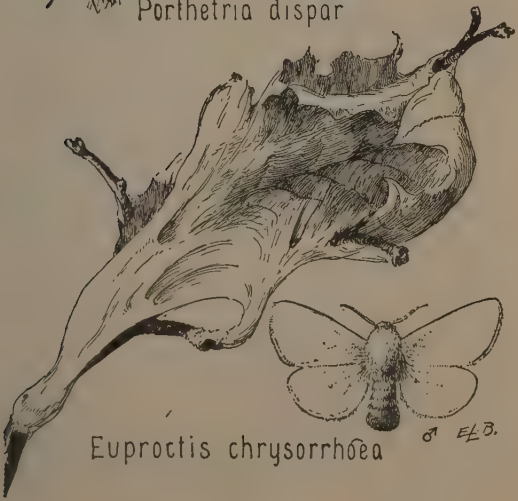
Hemerocampa leucostigma

tree free from this species, it may be kept free by banding the trunk with sticky paper, or the like, unless the tree is so close to others that larvæ may be blown to it. The reason back of this protective method is that the females can not fly.

**Porthetria dispar**

About 1868 an amateur entomologist in Massachusetts was breeding the Gypsy Moth (Plate LVI), using material which he had obtained from Europe. His reason for doing this has been variously stated; an excuse, which might now be made for him, is that "he did not know it was loaded." At any rate, some of the specimens went off and started to colonize America. Millions of dollars have since been spent in an effort, so far unsuccessful, to free us from the invader; the most that has been done has been to confine it to New England. The United States Bureau of Entomology is now engaged in an attempt to introduce from Europe parasites which there hold it, and the Brown-tail Moth, in check. The male Gypsy Moth is olive-brown; the whitish female rarely flies and then but feebly, although the wings are rather well developed. Adults appear from June to September but most abundantly in early July. The eggs, which are yellowish, nearly globular, and about a twentieth of an inch in diameter, are laid in masses of from less than 200 to more than 1000 and covered with buff-colored scales from the underside of the female's abdomen (See Plate LVI). These masses are placed anywhere that the female happens to be; as she does not crawl far from the pupal shell in which she dwelt and as the larvæ are much given to pupating under overhanging stones, on fences, buildings, wagons, railroad cars, and the like, as well as on vegetation, there is where the eggs are to be found. Though the larvæ may develop in a few weeks, they rarely hatch until the next April or May. More than five hundred species of plants, including conifers, are in their dietary. The full-grown larva is about 2.25 inches long, brownish-yellow with long hairs and four rows of tubercles; there is one tubercle of each row on each segment, those on the anterior segments being blue, those (especially of the two middle rows) on the posterior segments being red.

Porthetria dispar




Euproctis chrysorrhœa

The larvæ are largely nocturnal and spend the day congregated in colonies on a limb, trunk, or in some protected nook. They pupate about July, also often in colonies, each rather conical, dark-brown pupa, about an inch long, lying among a few threads, and securely attached to some of them by its terminal spine. If you should see something which you think may be the Gypsy Moth or the Brown-tail Moth, in any of their stages, send it at once to your State Entomologist or to the U. S. Bureau of Entomology at Washington.

**Euproctis chrysorrhœa**

We do not know how the Brown-tail Moth (Plate LVI) crossed the Atlantic from Europe, but it happened near Boston in the early nineties. Its American range is now from Rhode Island to Nova Scotia. Unlike those of the Gypsy Moth, these females fly freely, so that wind is a factor in their spread; they are white, except for the yellowish-brown hairs at the tip of their abdomen, which give them their name. The males are similar but smaller and the brown of their tails is not so conspicuous. Adults appear in July and fly abundantly to lights. The female covers her egg-mass, which is usually placed on the under side of a leaf, with brownish hairs from her body. The larvæ hatch in two or three weeks and feed in colonies, webbing together the tender terminal leaves. In this nest they pass the winter, when a third or half grown. The full-grown larva is about an inch and a half long, nearly black but with a red tubercle on the back of the ninth and tenth segments; it is clothed with hair, there being a row of nearly white tufts on each side of the body and the rest brownish. These hairs, especially the brown ones, are barbed and carry an irritating poison; furthermore, they are carried by wind when freed at molting times and, if they gain entrance to the human skin, give rise to "brown-tail rash." The larvæ feed on a wide range of plants, preferring apple, pear, wild cherry, oak, and maple. The cocoons are loosely spun, often in masses, in curled leaves, crevices in bark, and in other sheltered places. The pupal period averages about three weeks. See Gypsy Moth for advice.

LASIOCAMPIDÆ

**Malacosoma americana**

If the Tent-caterpillar (Plate LVII) were not so common and such a pest we who are interested in nature would be willing to go miles to see a colony. We might even bring eggs home so that we could have it in our garden. In some books you will find this species and *disstria* under *Clisiocampa*. The adults, which are dull yellowish or reddish-brown, appear in late June or early July. The female lays three or four hundred eggs in a band which encircles a small twig of some tree, preferably wild cherry or apple. This band is rounded at the ends and covered with a waterproof protective "varnish." The embryos develop before winter but do not emerge until the next spring. Their first act seems to be helping brothers and sisters spin a temporary silken tent around what is left of the egg-mass. If this is in a good place from which to go out for food, they may make their permanent tent here but usually they move, in several days, to a fairly large fork of the tree and there construct the, to us, unsightly web. The family sticks together until nearly full grown, resting in the tent during storms and the heat of the day and coming out to feed when it is cool but not too cold. On these excursions they follow, to some extent, definite paths which may be recognized by silken threads spun by the passing larvæ. They get *wanderlust* when full-grown. Perhaps I object to them then more than ever, for they crawl over everything. They are really hunting for a protected place in which to spin tough, oval, white cocoons, which are held in place by irregular threads. Considering that Nature helps us by giving this species many enemies, that the larvæ gather in all too conspicuous webs where we may conveniently burn them, and that even the eggs may be easily seen and removed during the winter, it is strange that people allow *M. americana* to exist. The reason probably is that its extermination requires community action. Last winter I picked all the egg-masses off my trees; in the spring the editor of our country paper published a long article telling how to combat the tent-caterpillar; he lives across the street from me but he did nothing to the big

colonies on an old cherry tree in his yard because he was going to cut the tree down in the autumn; this winter I must go all over my trees again.

**Malacosoma disstria**

The common name, Forest Tent-caterpillar, of this species (Plate LVII) is wrong for it makes no tent although closely related to *americana*. Its egg-masses resemble those of the other eastern species but are more square-cut at the ends. The larvæ eat the leaves of almost any deciduous tree but maple is said to be its favorite. They feed in colonies, when young. Many of the cocoons are placed in curled leaves.

### Bombycidæ

**Bombyx mori**

Perhaps the Commercial Silk-worm ought not to be in a Field Book since it is not a field-insect. It is probable that, even in its native home, it could not now exist wild since the larval legs have so degenerated that the larvæ cannot climb well. The entire family was originally confined to Asia. The larva will eat the leaves of several kinds of plants, such as Osage orange, but it does best on white mulberry. The adults have a wing-expanse of about 1.75 inches, are creamy white and, although the wings seem fairly well developed, the moths do not fly, perhaps because of generations of artificial confinement. Each female lays about three hundred eggs. There are many races which have been produced by man's selection; some have one while others may have as many as six generations a year, also the color of larvæ and cocoons differ. If labor were cheap enough in America to make the rearing of silk-worms pay, it is probable that some of our native Saturniidæ would be fully as profitable as this species.

### Geometridæ

Larvæ of this family are familiar to almost everyone, but only a small proportion of those larvæ which come within our range of vision are really seen, since most of them stiffen themselves and pass for a twig. Others, those

Malacosoma
americana
Malacosoma disstria

which develop into the small, delicate, green moths you may have noticed about the lights, cover themselves with bits of their food; when next you gather Black-eyed Susans and Field Daisies look carefully on the flowers for a collection of petals fastened to the back of a Geometrid larva (Plate LVIII). The name of this family means "earth measurers" and in English we call the larvæ Measuring-worms, Inch-worms, Span-worms, or Loopers. The saying that, when they walk on our clothes, they are planning a new suit for us is probably as logical as "earth-measuring" and more interesting to us personally. Their peculiar locomotion is due to their lacking all but two or three pairs of abdominal legs; with legs only at each end of the body they must hump themselves to get along. The adults are slender-bodied; their wings are broad and the pattern on the front wing is, in many cases, continued on the hind wings. Nearly a thousand species have been described from this country alone.

**Alsophila pometaria**

Imagine a tiny gray flower-pot having a gray cover decorated with a dark central spot and a dark ring near the edge; that is like an egg of the Fall Canker-worm, which also goes under the generic name of *Anisopteryx*. The female (Plate LVIII) places several hundred of them in a flat mass, keeping the rows regular, on the bark of almost any deciduous tree. This is usually done in November but sometimes not until spring. The larvæ, especially at first, skeletonize the leaves instead of eating them entirely; they get to be about an inch long, are black and have, on each side, a stripe of yellow below the spiracles and three narrower whitish stripes above them. These larvæ, like many of their relatives, often let themselves part-way down to the ground by means of a silken thread. If it is not your tree, it is rather amusing to see them climb up this thread again, for all the world like a sailor going up a rope. Once, about the first of June, they do not go back but instead go to a depth of from one to four inches underground, where they spin a thin, tough cocoon, pupate, and remain until October, November, or the next spring. The adult males are brownish-gray and

have good wings. The females have much the same color but are wingless. However, the females are not as sedentary as those of the Tussock Moth; they scramble out of the earth and make for a tree upon which to lay their eggs. This is where we can easily get the better of them, for we have only to put Tree Tanglefoot or some other barrier around the trunks of our trees and there will be no little Pometarias next spring. But there are two things to remember: first, one can never be quite sure when the females are going to come out, for they may choose a warm spell in mid-winter; and second, there is *Paleacrita vernata* (see p. 196).

**Hydria undulata**

This pretty moth (Plate LVIII) has its wings zigzagged with yellow and brown. It gets a paragraph because of its nest. The female lays a cluster of eggs in early summer on a terminal leaf of wild cherry. I do not know just how they do it but the larvæ fasten together the leaves at the end of the twig and the whole family feeds on the walls of the nest. When these walls are nearly eaten, the larvæ bend other leaves and fasten them against the nest so that they may have fresh walls to eat. Finally they all leave to pass the winter underground as pupæ. This species occurs also in Europe, but probably it is naturally on both sides of the Atlantic and not because of man's migrations.

**Synchlora ærata**

The adult (Plate LVIII) is a delicate pale green and the wings are crossed by two lighter lines. This description will fit many species of the subfamily Geometrinæ, but to make it more definite without becoming technical would be difficult. At any rate, it is the larva which is of interest here. It feeds on the fruit, and also on the foliage, of raspberry and blackberry. Like its relatives on the daisies (see p. 194) it covers itself with a heap of rubbish fastened to its back with silk.

**Cymatophora ribearia**

The larvæ of the Currant Span-worm (Plate LVIII) feed on the leaves of gooseberry as well as of currant bushes; they are yellow and plentifully spotted with dark brown. They

hatch in spring, just as the leaves are expanding, pupate underground about a month later, and the pale yellow, marked with brown, moths emerge several weeks later, say, in early July. The eggs are laid on the twigs of their food plant, usually near a crotch, but they do not hatch until the next spring. The eggs are ovoid, deeply pitted, and blue-green in color.

**Paleacrita vernata**

This is the Spring Canker-worm (Plate LVIII). According to Slingerland and Crosby, the term "cancer-worme" originated in England in 1530 and was used for several different insects in the first authorized English version of the Bible in 1611. In 1661 John Hull said "the canker-worm hath for four years devoured most of the apples in Boston, that the trees look in June as if it was the 9th month." For a long time *pometaria* (see p. 194) was not distinguished from *vernata*. The larvæ of *vernata* may be ash-gray, green, yellow, or even dull black; they have much the same habits as those of *pometaria* but the adults do not emerge from the underground pupæ until sometime between February and April, inclusive. The male's wings are silky gray. The female has no wings. She lays four hundred or more eggs in irregular clusters in crevices of the bark of some deciduous tree, fruit trees being favorites. These eggs are ovoid, slightly ridged, and of an iridescent purple color. My chief objection to this species is that it was the excuse for the introduction of the English sparrow. Tree bands would have been more effective and not such a nuisance.

**Ennomos magnarius**

The Notched-wing Geometer (Plate LVIII) is the largest common Geometrid of the Northeast. The wings are reddish yellow, shaded and spotted with brown. It flies from August to November. The larva, which gets to be more than two inches long, feeds on maple, chestnut, birch, and other leaves. It spins a dense, spindle-shaped cocoon within a cluster of leaves.

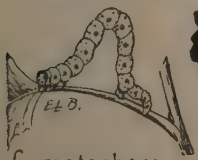
Alsophila pometaria

Paleacrita vernata

Hydria undulata

A Geometrid larva

Synchlora aerata




Cymatophora ribearia

Ennomos magnarius

## Micro-Lepidoptera

Under the above term, "Micros" for short, are roughly grouped a number of families of moths. Not only is the division not very satisfactory from a scientific standpoint, but, practically, many Macros are smaller than some Micros. The term super-family Tineoidea is sometimes used. The families of moths which follow are Micros.

### Psychidæ

**Thyridopteryx ephemeræformis**

Plate LIX shows a bag such as is frequently noticed on many sorts of trees, deciduous and coniferous. It is made of silk in which are fastened leaves or bits of stick. If we examine such bags during the winter, we will find many of them to be empty but others will be found full of soft yellow eggs. Riley, one of our pioneer economic entomologists, wrote as follows: "Those which do not contain eggs are the male bags and his empty chrysalis skin is generally found protruding from the lower end. About the middle of next May these eggs will hatch into active little worms, which from the first moment of their lives, commence to form for themselves little bags. They crawl on to a tender leaf, and, attached to their anterior feet with their tails hoisted in the air, they spin around themselves a ring of silk, to which they soon fasten bits of leaf. They continue adding to the lower edge of the ring, pushing it up as it increases in width, till it reaches the tail and forms a sort of a cone. As the worms grow, they continue to increase their bags from the bottom, until the latter become so large and heavy that the worms let them hang instead of holding them upright, as they did while they were young. This full grown condition is not attained, however, without critical periods. At four different times during their growth these worms close up the mouths of their bags and retire for two days to cast their skins or moult, as is the nature of their kind, and they push their old skins through a passage which is always left open at the extremity of the bag, and which also allows the passage of excrement. During their growth they are very slow travel-

lers and seldom leave the tree on which they were born, but when full grown they become quite restless, and it is this time that they do all their travelling, dropping on to persons by their silken threads and crossing the sidewalks in all directions. A wise instinct urges them to do this, for did they remain on one tree, they would soon multiply beyond the power of that tree to sustain them and would in consequence become extinct. When they have lost their migratory desires, they fasten their bags very securely by a strong band of silk to the twigs of the tree on which they happen to be. A strange instinct leads them to thus fasten their cocoons to the *twigs* only of the trees they inhabit, so that these cocoons will remain secure through the winter, and not to the leaf-stalk where they would be blown down with the leaf. After thus fastening their bags, they line them with a good thickness of the same material, and resting awhile from their labors, at last cast their skins and become chrysalids. Hitherto the worms had all been alike, but now the sexes are distinguishable, the male chrysalis being but half the size of the female chrysalis. Three weeks afterwards [late August or early September] a still greater change takes place, the sexes differentiating still more. The male chrysalis works himself down to the end of his bag and, hanging halfway out, the skin bursts and the moth with a black body and glassy wings escapes, and when his wings are dry, soars through the air to seek his mate. She never leaves her case, but issues from her chrysalis in the shape of an abortive, footless, and wingless affair and after copulating, works herself back into the chrysalis skin, fills its upper but posterior end with eggs and stops up the other end with what little there is left of her body when she gets through."

*Oiketicus abboti* of the Southern States places short pieces of twigs across the bag, making sort of a log cabin.

The larvæ of the small family Lacosomidæ also make cases of leaves and silk. These "bags" are rather widely open at both ends. They are not usually common, but are to be looked for on oak.

## LIMACODIDÆ

The larvæ of this family are curious, slug-like creatures, with almost nothing resembling legs. They crawl on their flattened bellies. Be careful about handling them, if they have spines, as these are easily broken off and are extremely irritating things to get in one's skin. Some authors use "Cochlidiidæ" as the family name.

**Sibine stimulea**

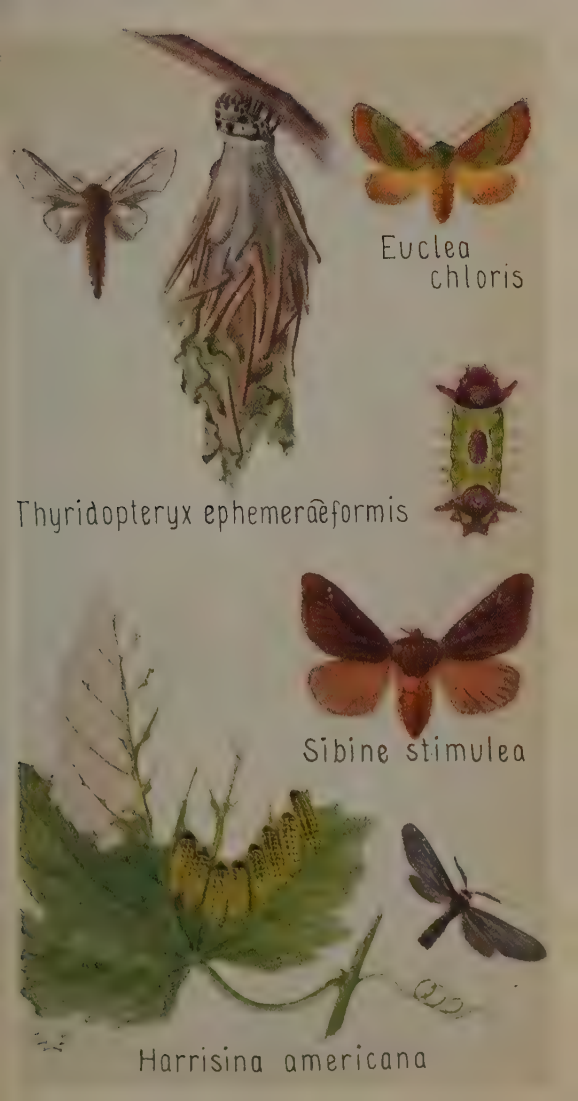
The Saddle-back larva (Plate LIX) is often noticed by reason of its curious shape and color. It feeds on apple, pear, cherry, and other things, including corn. Its spines sting like nettles but the pain may be allayed by ammonia or bicarbonate of soda. The larvæ are full grown in late summer and the adults fly during June and July, so that I suppose the winter is passed in a cocoon but whether as larva or pupa I know not. Dyar and Morton (*Journal N. Y. Ent. Soc.*, IV) figure the cocoon as a smooth ovoid on a leaf and say that the larval hairs imbedded in it retain their stinging qualities.

**Euclea chloris**

See Plate LIX for the adult Green Slug-moth. The larva is bright scarlet with four blue-black lines along the back and with yellow prickles. Sometimes, possibly it is when a molt is due, the ground-color of the larva is brownish yellow. The cocoon is dark brown, egg-shaped, smooth, and very thin. The larva hibernates in this cocoon, not changing to a pupa until spring. The adults fly in June and July. These adults may be confused, at first, with those of other species of *Euclea*.

**Phobetrom pithecium**

"Hag-moth" refers to the larva which is dark brown with eight, relatively long, fleshy, hairy appendages, which cover the back and project from the sides of the larva and have a backward twist, like locks of disheveled hair. They are, in fact, fleshy hooks covered with feathery, brown hairs among which are longer, black, stinging hairs. The cocoon is almost spherical, and is defended by the hairy


Euclea
chloris
Thyridopteryx ephemeraeformis
Sibine stimulea
Harrisina americana

appendages, which the larva in some way contrives to leave on the outside. These tufts give to the bullet-shaped cocoon a nondescript appearance and the stinging hairs afford a very perfect protection against birds and other insectivorous animals. "Unlike other species of Limacodidæ, the Hag-moth larvæ do not seek to hide away their cocoons, but attach them to leaves and twigs fully exposed to view, with, however, such artful management as to surroundings and harmonizing colors that they are, of all the group, most difficult to discover. A device to which this insect frequently resorts exhibits the extreme of instinctive sagacity. If the caterpillar can not find at hand a suitable place in which to weave its cocoon it frequently makes for itself more satisfactory surroundings by killing the leaves upon which, after they have become dry or brown in color, it places its cocoon" (Hubbard). The larva is a rather general feeder and has been found on most orchard trees as well as on wild trees and shrubs in late summer. The adults fly in midsummer; the female is brownish, marked with yellow; the male is much like that of *T. ephemeræformis* (Plate LIX) but smaller.

## Megalopygidæ

**Megalopyge crispata.**

It is the cocoon of the Crinkled Flannel-moth which gets this family into the Question-box and *crispata* is the only northeastern species which is at all common—it is only locally so in New Jersey, for example, although it ranges from Massachusetts southward and is found at least as far west as Minnesota. The larva feeds on raspberry, blackberry, apple, and other leaves. Like other larvæ of its family, it is extra well provided with legs, having the usual three pairs on its thorax and, according to Eliot and Soule, seven pairs on its abdomen. It is an oval, very hairy affair; the hairs are brown and form a ridge along the larva's back sloping off on each side. The tough oval cocoon is fastened to the side of a twig very securely indeed and here the creature hibernates; but what arouses one's interest is that when the moth emerges, about July, it does so by lifting a flat circular lid at one end of the cocoon. The adult is a soft,

fluffy, yellowish moth, with a wing expanse of about an inch and a quarter or a little more; the front wings have irregular brownish markings near the front margin and rows of fine, curly, hair-like scales; the body is thick and woolly.

### Pyromorphidæ

These are small, blackish moths, often with brilliant markings, most of our species having a red collar.

**Harrisina americana**

If you have ever seen these larvæ on the leaves of grape or Virginia creeper (Plate LIX), you will recall the sight, but there are other larvæ which feed on other plants in the same orderly fashion. This species pupates in a white oval cocoon underground. Some of the adults emerge, after a pupal existence of only about two weeks, but other pupæ winter over. The yellow eggs are laid in loose clusters of about a hundred on the under side of the food-plant's leaves.

### Cossidæ

The adults' appearance suggests Sphingidæ but they have a very small head and almost no tongue; furthermore, they, especially the females, are very feeble fliers. All the strength seems to be in the larvæ, which bore in the wood of trees. The adults are sometimes called Goat-moths, presumably on account of their odor.

**Zeuzera pyrina**

The Leopard-moth is an immigrant from Europe, undesirable but interesting, which is still largely confined to the vicinity of New York City. The adult male (Plate LX) is only about two thirds as large as its mate; the semitransparent wings of each are white, spotted with black. The grub-like larva is pale yellowish, sometimes pinkish, except for numerous brownish-black spots. They bore in almost any tree and in many shrubs. If the young larva starts, as it usually does, in a twig which is too small for its con-

tinued existence, it crawls out and bores in a larger branch. Larval life takes nearly two years. Pupation occurs about May in the last larval burrow and adults emerge during June and July. Each female places well on to a thousand eggs in soft, young wood and in crevices of old bark.

We also have native species of Cossidæ, the commonest probably being *Prionoxystus robiniæ*. Its larvæ bore chiefly in oaks but also in chestnut, poplar, willow, maples, ash, and, as its name indicates, locust. Lugger says the larva is bad smelling, reaches a length of 2.5 inches, and after about three years of eating wood spins a loose cocoon in its burrow. The adult female's wings expand about 2.5 inches; they are gray with irregular black lines and spots. The male is hardly more than half as large; his front wings are darker than the female's, and his hind wings are yellowish.

### ÆGERIIDÆ

It is sad, but apparently true, that Sesiidæ, the commonly used name of this family, must, according to the rules of the game, give way to Ægeriidæ. Those of you who are just starting are fortunate in not having to unlearn that, at least, old name. The wings of the Ægeriidæ are usually more or less transparent and the adults depart from the usual habits of moths in that they fly by day (see also *Hemaris*). Please do not take "protective mimicry" too seriously but I quote Lugger in order to give the idea. "Many of the species of moths belonging here are very beautiful, and most of them are remarkable on account of the protective mimicry exhibited by them. This close resemblance to insects of different orders was observed long before the significance of protective mimicry was understood. The majority of the Sesiidæ mimic bees, wasps, and flies. We all know from experience that bees and wasps can advance some very pointed arguments to be left alone, and any other insect that closely mimics such well armed warriors is very apt to be left unmolested. This mimicry is not simply a superficial one, since even their motions, if captured or disturbed, are like those of the insects imitated. Their attitude when resting, the

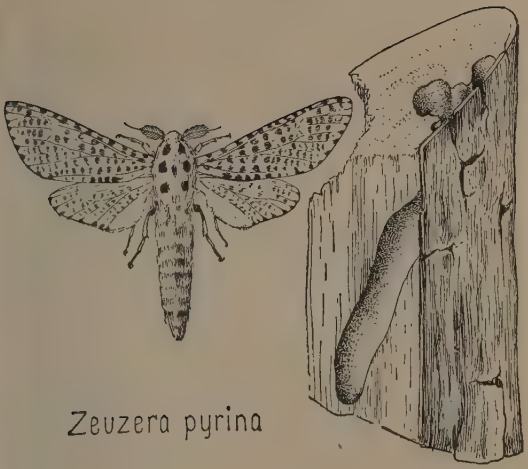
sounds they produce, their hyaline wings, their ringed body, even the odor they give off, all are apt to warn us and to caution us. Yet though they pretend to sting they lack the necessary organ for that purpose." The larvæ are all borers and, like most concealed larvæ, rather uniformly yellowish-white except for their heavily chitinized parts, such as the head, which are darker. To illustrate the life histories I have selected some of those species which may be living in our yards. There are many more afield.

**Melittia satyriniformis**

The larva will be found in almost any cucurb but prefers squash or pumpkin. It lives in the stems, causing them to rot; and Sanderson states that as many as forty larvæ have been taken from one vine. When full grown (about an inch long), the larva leaves the plant and, going an inch or two below the surface of the ground, spins a tough cocoon the outer silk of which is well mixed with particles of earth. In the South pupation takes place at once and a second generation appears in July but in the North the larva hibernates in its cocoon and does not pupate until spring. The pupa has a horn-like process between its eyes which is said to be used in cutting the cocoon. At any rate, it gets to the surface in some way and the adult emerges from April to September according to latitude and other conditions. See Plate LX; the front wings are opaque, olive green, and have a metallic luster; the hind wings are transparent; the abdomen and legs are reddish, the former being marked with black and bronze and the hind legs having a long black fringe. The dull red, oval eggs are laid singly.

**Memythrus polistiformis**

As the specific name indicates, this moth bears some resemblance to the wasp, *Polistes*. See Plate LX; the front wings are opaque and dark brown; the hind wings are transparent, the male's being rather yellowish; the abdomen is brown, with yellow lines on the second and fourth segments; the legs and the sides of the thorax, especially the male's, are reddish. Each female lays several hundred chocolate-colored, finely sculptured eggs with apparent



Zeuzera pyrina

Melittia satyriniformis

Memythrus polistiformis

Sanninoidea exitiosa

carelessness on almost any vegetation near grape vines. These eggs are washed by rains to the ground where the larvæ hatch and burrow into the earth searching for a grape root in which to feed. The larval life lasts for nearly two years, the first winter being passed naked in the burrow and the second enclosed in a thin hibernaculum of silk. This, however, is not the cocoon, for when spring comes the larva works its way to near the surface of the ground where it makes a tough cocoon of earth, excrement, and silk within which it changes to a brown pupa with a yellow-banded abdomen. About a month later (July or August) the pupa comes half-way out of the ground and the adult is freed.

**Bembecia marginata**

This is the Raspberry Root-borer or Blackberry Crown-borer, both names indicating the food habits of the larva, while the generic name suggests the resemblance which some of the adults of the genus bear to certain wasps (*Bembex*). The female of this species has a wing expanse of about 1.5 inches; the front wings are transparent except for the brown margins, tips, and a band which crosses each wing at about two thirds of the distance from the base to the tips; the hind wings are altogether transparent (except, of course, for the veins and outer fringe which are opaque in most, if not all, species); the abdomen is banded with brownish-black and yellow, the former color predominating in front, the latter behind; the legs are largely yellow. The male is somewhat smaller than the female and his abdomen has less yellow at the hind end. The moths emerge in, usually, late summer; the eggs are laid on the canes close to the ground; and the larvæ, on hatching, crawl down the stem where they hibernate under the bark just below the surface of the ground. In the spring they start to bore into the roots or the base of the plant, often girdling it. They spend the second winter in their burrows and the following spring work upward in the plant to a point above ground where, just inside the bark, they pupate. About a month later the pupa cuts the bark with its "horn," crawls partly out, and the adult emerges to mate and start the history anew.

**Sanninoidea exitiosa**

The Peach-tree Borer (Plate LX) is living just outside my back door and I am not philosophical enough to enjoy its neighborliness. I have seen an estimate of $6,000,000 given for the annual damage done by it—not all on my lot, of course. This species ought to have stuck to wild cherries and plums, which are believed to have been its original food, although it also feeds on willow. The afflicted trees display distress signals by exuding large masses of gum where the larvæ are working, which is usually near the surface of the soil. The insect passes the winter as a half-grown larva. After attaining its full growth early the next season, the larva leaves its burrow (usually) and makes its unkempt cocoon of excrement, pieces of bark, gum, and silk on the trunk of the tree or on the earth. About a month later (which may be from June, or earlier in the South, to September) the adults appear. They have a wing expanse of an inch or more but the sexes differ markedly in appearance. The female is dark steel-blue (sometimes with a reddish glint) except for the transparent hind wings and the orange band which covers the fourth and, in the North, the fifth abdominal segments. All the male's wings are transparent, with blue edgings and blue crossbands like those of *marginata;* the body is blue, banded with white or light yellow. Each female lays from 200 to 800 eggs, about a fiftieth of an inch long and much the color of the bark on which they are placed. I have never seen them but, according to the pictures, they are very pretty. I will admit that the adults, also, are pretty. There is a generation every year. This species does damage wherever peaches are grown in this country, although it is an eastern species; on the Pacific coast it is joined in the work of destruction by *San.inoidea opalescens.*

**Synanthedon tipuliformis**

We can blame this on Europe, but it is now well naturalized, having been here for about a hundred generations. It also occurs in Asia and Australia. We would expect, from its name, that it is very long-legged, like Tipulidæ, but it is not. Both sexes have both pairs of wings transparent

except for the golden markings, with purple reflections. The body is dark purple, with three yellow abdominal bands in the female and four in the male. The brown, spherical eggs are placed singly on currant stems, and the larva works up or down the pith. The larvæ hibernate when nearly full-grown; pupate the following spring in a silk-lined cavity just under the bark; and emerge during June and July. There is one generation a year.

**Synanthedon pictipes**

*Synanthedon* is the genus *Sesia* of authors, the name *Sesia* properly belonging to a genus of Sphingidæ. The work of this species is often confused with that of *exitiosa*, but *pictipes* prefers old trees with rough bark and works more often on the trunk and larger branches than at the base of the trees. Its cocoon is similar to that of *exitiosa* but smaller. The adults, both sexes of which resemble the male *exitiosa*, are also smaller. They fly during June and July. It is said that this species attacks June-berry and chestnut in addition to those three "favored" by *exitiosa*, but it rarely does much damage to any.

## Pyralidæ

This is a large family of small moths and, although a number of the species are somewhat expensive to the farmer, he often does not know what is the matter. The group does not seem to be a "popular" one. The following are samples of some of the subfamilies.

### Pyraustinæ

The wings are rather thinly scaled. Most of the species are yellow and white. The larvæ usually live in webs, sometimes socially.

**Desmia funeralis**

The adult of the Grape Leaf-folder does not have the more or less typical coloration of the sub-family; it is brownish-black, with two white spots on each front wing and one (some-

times divided in the female) on each hind wing. The larva feeds on the upper surface of a grape leaf, folding the leaf over and fastening it by strands of silk. Pupation takes place in the folded leaf. The pupæ of the second annual generation hibernate in their retreats, which have fallen to the ground.

**Loxostege similalis**

This species is sometimes called "Garden Web-worm" but it is more at home on weeds than on garden plants. The markings of the yellowish and grayish-brown adult are difficult to describe in a few words. The thing which is apt to attract attention in the "field" is the black-spotted, yellow larvæ in their fine web, which encloses skeletonized leaves. They pupate in silk-lined, underground cells.

Larvæ of *Symphysa adelalis* feed on white lichens on the trunks of oak and other trees, making large, dumbbell-shaped cases for themselves of the lichens.

Larvæ of *Blepharomastix limata*, between folded oak leaves.

Larvæ of *Diaphania nitidalis* and *hyalinata*, in stems of Cucurbitaceæ.

Larvæ of *Pyrausta theseusalis* web up tips of ferns; of *P. penitalis*, in stems of lotus and cat-tail (*Typha*).

## Nymphulinæ

Small, for the most part brightly colored species, with narrow wings, the front pair being more or less angular. Many of the larvæ live on water plants and are semi-aquatic. Their life histories are probably interesting but have not been carefully studied. The young larvæ may have gills. The larvæ of *Nymphula obliteralis* live in cases on the leaves of greenhouse water-plants.

## Pyralinæ

This subfamily contains some rather troublesome species such as the following:

**Pyralis farinalis**

The larva of the Meal Snout-moth lives in cereals, flour, and clover hay. It is whitish, a bit darkened at the ends, and has a reddish head. It lives in a long tube, which it makes by fastening its food-material together with silk. Pupation occurs in a cocoon outside of the tube. The adult has a wing expanse of about .75 inch. It may be recognized by the front wings, which have chocolate-colored bases and tips, separated from the light-brown central area by curved white lines. It is rather generally distributed by commerce. There are from two to four generations a year, depending on temperature and other conditions.

The larva of *Hypsopygia costalis* is the Clover-hay Worm and is sometimes injurious.

## Crambinæ

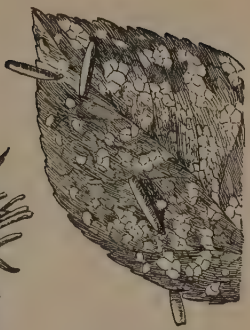
The narrow front wings are sometimes drawn to a point and are usually whitish, ornamented with golden or silvery scales; the hind wings are broad and without markings; the palpi are very long. When at rest, the wings are wrapped so closely to the body that the moths look like small cylinders. The larvæ live in silken tubes just above or below the surface of the ground.

The larva of *Prionapteryx nebulifera* in the Jersey pine-barrens makes of silk and sand a tube leading from an underground retreat to the leaves of sand-myrtle and huckleberry upon which it feeds. At night it carries pieces of leaves to its retreat for daytime meals.

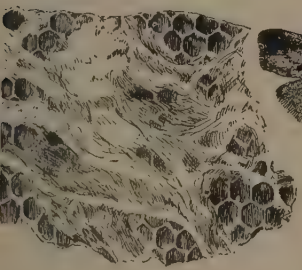
Most of the larvæ of *Crambus* feed on grasses; that of *C. vulvivagellus* (The Vagabond, Plate LXI) is sometimes very destructive, feeding by night, and retiring by day to a tube of cut grass and silk just below the surface of the ground; *C. caliginosellus* has similar habits and, especially in the South, injures tobacco.

Larvæ of *Chilo plejadellus* bore in the stems of rice and allied plants.

Crambus vulvivagellus



Coleophora fletcherella



Galleria mellonella

Oxyptilus periscelidactylus

## Galleriinæ

**Galleria mellonella**

The adult Bee-moth (Plate LXI) has purplish-brown front wings and pale brown or yellowish hind wings. The female probably enters the bee-hives at night and lays her eggs while the bees are asleep for, when awake, they actively and successfully resent her presence. The larvæ feed by night on the wax of the combs. They make silken galleries in which they hide during the day. The tough cocoons are usually placed against the side of the hive. The Bee-moth is found almost everywhere that honey-bees are kept but its original home, probably Asia, is unknown.

## Phycitinæ

For the most part, these are a silky gray. Nearly all the larvæ live in silken tubes, which may be in the stems of plants, in seeds, in flower heads, or in crumpled leaves. *Lætilia coccidivora* feeds on the Tulip Soft Scale and the Cottony Maple Scale.

**Mineola indiginella**

There are many Leaf-crumplers but this species is apt to be noticed on home grounds. It has not been troublesome since spraying for the Codling Moth became general. The larvæ feed on apple, plum, and cherry. In winter we can find withered crumpled leaves fastened to twigs. If these leaves conceal a larva encased in a tube of silk and frass, looking like a small, much-twisted horn, we probably have this species. In the spring, after banquets on young leaves, the larva pupates in its case and the adults, with silver-marked, pale brown, front wings, emerge about July.

The larvæ of *Mineola vaccinii* is the Cranberry Fruitworm.

**Ephestia kuehniella**

The Mediterranean Flour-moth was first noticed in America about 1889. It is now rather widely distributed in flour, "feed," and cereals. The cylindrical larva is the color of pink flesh, with sparse, long hairs and a reddish-brown head. Not only do the larvæ destroy by eating, but they also spin threads as they move about, so that the material in

which they are becomes thoroughly mixed with webs. The larvæ are sometimes so abundant in flour mills that the spouts and machinery become absolutely clogged with silk. The thin cocoons are usually placed on some dried substance and often have foreign material imbedded in the silk. The wing expanse is somewhat less than an inch; the front wings are dark gray crossed by wavy lines, the V-shaped marks near the bases making a W when the wings are closed; the hind wings are silvery gray and both are fringed with long hairs. Breeding continues throughout the winter in warm places, giving as many as four or five generations a year.

**Plodia interpunctella**

The common name, Indian-meal Moth, is not inclusive enough, for the larva is fond of all sorts of stored foods, including nuts and raisins. It was called Indian-meal Moth by Fitch, who found it in corn-meal in 1856. The larva can usually be distinguished from those of similar habits by a pale line which divides the brown thoracic shield in halves; it is an active creature which goes backward about as well as forward and it spins a web wherever it goes. The cocoon is usually placed in a crack or corner. The wing-expanse is a little more than half an inch; the front wings are creamy-white at their bases, and reddish-brown, marked with black, beyond; the hind wings are dingy gray and fringed with long hairs. There are three or more generations a year, depending largely on temperature.

Larvæ of *Acrobasis demoiella* bore into the ends of walnut twigs; of *A. angusella* into hickory leaf-stems; of *A. caryæ* into the twigs of hickory; of *A. rubrifasciella* live in cases between leaves of sweet fern (*Comptonia*) and of alder; of *A. betulella* in tubes between birch leaves; of *A. comptoniella* in cases between the terminal leaves of *Comptonia* and *Myrica*.

Larvæ of *Pinipestis zimmermanni* bore in pine.

Larvæ of *Salebria afflictella* live in tubes of silk and excrement between leaves of sweet gum.

Larvæ of *Melitara prodenialis* bore in the leaves of prickly pear (*Opuntia*).

Larvæ of *Zophodia grossulariæ*, in gooseberries.

Larvæ of *Euzophera semifuneralis* bore under bark of plum and cherry.

### Pterophoridæ

If I should ever take up Lepidoptera as a hobby, I might be tempted to specialize on these delicate "Plume Moths." The adults may be recognized by the fact that their wings, at least the hind ones, are split so as to form plumes; they are all small and long-legged. The larvæ suggest miniature Arctiids but, in addition to structural differences, they may be distinguished from Woolly-bears by their habit of living in tubes and loose webs. The pupæ are soft, hairy, and hang by their tails like butterfly chrysalids, although a few make an attempt at constructing cocoons. The family is not a large one; less than twenty species have been recorded from New Jersey, for example, and, with the exception of *periscelidactylus*, none seem to be very common.

**Oxyptilus periscelidactylus**

See Plate LXI. Once again we quote from Riley's model reports on the *Noxious, beneficial and other insects of the State of Missouri:* "The larva of the Grape-vine Plume invariably hatches soon after the leaves begin to expand; and though it is very generally called the Leaf-folder (from the fact that the larvæ live in a nest made by folding several leaves together), it must not be confounded with the true Leaf-folder [*Psychomorpha epimensis* of the Agaristidæ], which does its principal damage later in the season. At first the larva of our Plume is smooth and almost destitute of hairs, but after each moult the hairs become more perceptible, and when full grown the larva [has] hairs arising from a transverse row of warts, each joint having four above and six below the breathing pores. After feeding for about three weeks, our little worm fastens itself securely by the hind legs to the underside of some leaf or other object, and, casting its hairy skin, transforms to the pupa state. This pupa, with the lower part of the three or four terminal joints attached to a little silk previously spun by the worm, hangs at a slant of about 40°. It is of peculiar and characteristic form, being ridged and angular, with

numerous projections, and having remnants of the larval warts; it is obliquely truncated at the head, but is chiefly distinguished by two compressed sharp-jointed horns; it measures, on an average, rather more than one-third inch, and varies in color [according to the color of the background on which it is formed] from light green with darker green shadings, to pale straw-color with light brown shadings. . . . The moth escapes from this pupa in about one week, and, like all the species belonging to the genus, it has a very active and impetuous flight, and rests with the wings closed and stretched at right angles from the body, so as to recall the letter T. It is of a tawny yellow color, the front wings marked with white and dark brown, the hind wings appearing like burnished copper, and the legs being alternately banded with white and tawny yellow."

We have, in the Northeast, a species of a related family, ORNEODIDÆ. It is called *Orneodes hexadactyla*, each wing being divided into "six fingers," making twenty-four altogether.

### TORTRICIDÆ

Like Pyralidæ, this is a large family of small moths. It gets its name from the habit, which many of its members have, of rolling leaves in order that they may have a sheltered place in which to feed. However, not all Tortricid larvæ roll leaves and not all leaf-rollers are Tortricids. The front wings are rather broad and usually square-cut at the outer end. When at rest, the wings are folded against the body. The following are examples of the principal subfamilies.

#### Olethreutinæ

**Polychrosis viteana**

The worm of most wormy grapes is the larva of this species. If no accident, such as being eaten by humans, happens to this larva, it will leave the grape berry and go to a leaf. Here it cuts a little flap, pulls the flap over and fastens it down to the main leaf with silk; the inside is then lined with silk and within this snug retreat the larva pupates. When this operation is carried on near the middle of the leaf, two flaps are cut and drawn together to make the shelter.

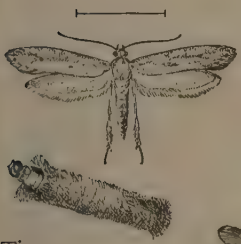
Finally, the frosts drop the leaf and winter is passed on the ground. The first annual generation of adults emerges about June first. They are purplish-brown moths with a wing-expanse of somewhat less than half an inch. The first-generation larvæ feed on the grape blossoms and young grapes, making a slight web about them. They pupate as described, and the second-generation adults emerge in mid-summer. Occasionally there is a third generation.

**Carpocapsa pomonella**

Most of us have heard of the Codling Moth or Apple-worm (Plate LXII) and nearly all of us have bitten into its larval galleries. Like the majority of our insect pests, it came to us from Europe, in its case about 1750. In 1909 Quaintance estimated that it destroyed annually $12,000,000 worth of fruit and that $4,000,000 were expended annually in attempts to control it, not counting the salaries of professional entomologists! Mature larvæ pass the winter in cocoons placed, usually, on trunks of trees and rendered less conspicuous by having bits of bark mixed with the silk. The larvæ pupate in the spring, sometimes leaving their hibernaculum to spin a new, thinner cocoon, and at other times merely breaking open the hibernaculum and closing it again with a thin layer of silk through which the pupa can push in order to free the adult. These adults, which have a wing expanse of about .75 inch and fly just after apple-blossom time, are well described by Slingerland and Crosby: "The front wings have the general appearance of watered silk, this effect being produced by alternating irregular lines of brown and bluish gray. Near the hind angle is a large, light brown area bounded on the inner side by an irregular chocolate brown band and crossed by two similar bands of metallic coppery or golden color in certain lights. The hind wings are coppery brown, darker towards the margin. The sexes are very similar, but the male may be distinguished by the presence of an elongate dark area on the underside of the fore wing and a pencil of black hairs on the upper surface of the hind wing." The scale-like eggs, about half the size of a pin-head, are usually laid on the

Carpocapsa pomonella

Archips rosana



Tinea pellionella

Leaf-mines

leaves and now is the time to start spraying, for the larvæ take a few mouthfuls of foliage before they bore into the young fruit. This generation usually goes in at the blossom end of the apple but later generations often go in at the side; in any case it is not so much the amount of apple they eat that worries us as it is the difficulty in missing their excrement-filled burrows, and themselves, when we come to eat the fruit. Most of the larvæ leave their burrows before the apple falls, and crawl down the limb to a suitable place for making a cocoon. There are from one to three, or more, generations a year, depending on climate. While this is distinctly an apple-worm, it feeds also on pears, quinces, and even English walnuts. It is found pretty nearly everywhere that apples are grown.

Mexican "jumping beans" are usually seeds of a species of Croton which contain a wriggling larva of *Carpocapsa saltitans*. Kellogg says that another Tortricid larva, *Grapholitha sebastianiæ*, has similar habits.

Larvæ of the genus *Rhyacionia* feed in the shoots or bark of pines and hibernate in the shoots or in the masses of exuded resin.

Larvæ of *Polychrosis liriodendrana*, in silken tents on the under surface of tulip-tree leaves; of *P. magnoliana*, in tents on the under surface of magnolia leaves.

Larvæ of *Cymolomia exoleta* crumples gooseberry leaves; of *C. inornatana* crumples wild cherry leaves.

Larvæ of *Olethreutes daeckeana*, in stalks and leaves of the pitcher plant (*Sarracenia*); of *O. cyanana*, in rose shoots; of *O. hebesana*, in seed pods of Tigridia, Iris, and other plants; of *O. hemidesma* bind together leaves and make galleries in flower spikes of Spiræa; of *O. chionosema* twist apple leaves.

Larvæ of *Pseudogalleria inimicella*, in stems of cat-briar (*Smilax*).

Larvæ of *Eucosma cataclystiana*, in stems of rag-weed (*Ambrosia*); of *E. strenuana* make spindle-shaped galls in *Ambrosia* stems; of *E. otiosana*, in stems of beggar-ticks (*Bidens*); of *E. suffusana* (an introduced European species), in flower buds and on young leaves of cultivated roses; of *E. juncticiliana*, in goldenrod stems; of *E. dorsisignatana*, in roots of the same; of *E. nisella*, in willow catkins; of

*E. scudderiana, desertana*, and possibly *obfuscana*, in galls on the stems of goldenrod but the galls themselves are probably made by *Gnorimoschema gallæsolidaginis;* of *E. tripartitana*, in Cecidomyid galls on stems of Black-eyed Susan (*Rudbeckia*).

Larvæ of *Cydia signatana*, in tubes of silk and excrement under a web on underside of maple leaves; of *C. timidella*, in similar tubes on underside of oak leaves.

Larvæ of *Episimus argutanus* twist leaflets of sumac and leaves of other plants into a spiral tube.

Larvæ of *Proteoteras æsculanum*, in stems of horse-chestnut leaves.

Larvæ of *Enarmonia piceafoliana* and *ratzeburgiana* mine spruce needles; of *E. pyricolana*, in rosebuds.

Larvæ of *Ancylis comptana* roll strawberry (chiefly), blackberry, and raspberry leaves; of *A. platanana* make tents between veins of underside of sycamore leaves.

Larvæ of *Laspeyresia caryana*, on hulls of hickory and walnut; of *L. prunivora*, in thorn apples (*Cratægus*); of *L. nigricana*, in pods of cultivated peas.

Larvæ of *Ecdytolopha insiticiana*, in gall-like swellings in twigs of locust.

Larvæ of *Mellisopus latiferreana*, in fallen acorns.

Larvæ of *Rhopobota vacciniana*, the Vine-worm or Black-head, on cranberry.

Larvæ of *Spilonota ocellana*, in buds of apple and other fruit trees.

Larvæ of *Phthinolophus indentanus* web leaves of huckleberry and bayberry.

## Tortricinæ

The larvæ of *Peronea minuta* is the Fire-worm or Yellow-head of the cranberry.

Larvæ of *Cenopis saracana* crumple leaves of sassafras; of *C. testulana* fasten together wild cherry leaves.

Larvæ of *Archips fervidana* make nests on oak and cherry, sometimes "thousands" join together and web up an entire bush or small tree.

The larvæ of *A. rosana* (Plate LXII) feed on the leaves of currant and other small fruits, orchard and shade trees.

Larvæ of *Eulia pinatubana* live in tubes made by fastening together the needles of white pine and then feed on the outer ends.

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We now come to a series of families which contain "really righty" *micro*-lepidoptera, but, as Smith said, "many of them are veritable gems of beauty, far exceeding in brilliancy and richness their relatives of larger size." The larvæ are largely miners in leaves.

"And there's never a blade nor leaf too mean
To be some happy creature's palace."

### YPONOMEUTIDÆ

Larvæ of *Plutella maculipennis* are common on cabbage and other crucifers; the pupæ can be easily seen through the delicate, lacy cocoons on the cabbage stalks.

Larvæ of *Argyresthia thuiella* mine arbor-vitæ leaves.

### GELECHIIDÆ

**Sitotroga cerealella**

The Angoumois Grain-moth is another pestiferous importation from Europe and "receives its name from the fact that in 1760 it was found to swarm in all the wheat-fields and granaries of Angoumois and of the neighboring provinces [of France], the afflicted inhabitants being deprived of their principal staple, and threatened with famine and pestilence from want of wholesome bread." It apparently landed in North Carolina about 1730. The larvæ feed within the seeds of wheat, corn, oats, rye, barley, sorghum, and cowpeas, eating to, but not through, the surface. The creature hibernates as a larva wrapped in silk, and pupates in the spring. The adult, which resembles the ordinary clothes-moth, emerges in May or June and oviposits on the young grain-heads. There are two or three generations a year.

Larvæ of *Metzneria lapella* feed on seeds of burdock, hibernating in the burs.

Larvæ of *Platodora similiella*, in sunflower heads.

Larvæ of *Telphusa belangerella* are rollers of alder leaves.

Larvæ of *Aristotelia roseosuffusella* mine red-clover leaves and live also in fruit panicles of sumac; of *A. fungivorella* web leaves of bayberry.

Larvæ of *Recurvaria apicitripunctella*, in hemlock leaves; of *R. piceaella*, in spruce leaves; of *R. obliquistrigella* and *juniperella*, in juniper leaves; of *R. thujaella*, in arbor-vitæ leaves, sometimes making the trees look burned; of *R. robiniella* each fasten flatly together two leaves of locust.

Larvæ of *Trypanisma prudens*, under a slight web on upper side of oak leaves.

Larvæ of *Paralechia pinifoliella* mine needles of *Pinus rigida;* of *P. cristifasciella*, between spun-together oak leaves.

Larvæ of *Phthorimæa operculella* mine stored potatoes.

Larvæ of *Gnorimoschema gallæsolidaginis* make spindle-shaped, gall-like swellings in goldenrod (*Solidago*) stems; of *G. solidaginella* have similar habits but are said to be confined to *Solidago sempervirens;* of *G. buskiella* and *gallæsteriella* make galls in aster stems.

Larvæ of *Anacampsis innocuella*, in curled leaves of poplar; of *A. lupinella*, in folded-together leaves of *Lupinus perennis.*

Larvæ of *Gelechia serotinella* each fasten together the edges of a wild cherry leaf and live within a tube of silk and frass placed in the fold.

### Stenomatidæ

Adults of *Stenoma*, when at rest, resemble gray and white bird droppings.

### Œcophoridæ

Larvæ of *Eumeyrickia trimaculella*, in spruce stumps.

Adults of *Agnopteryx* and *Despressaria* often hibernate in outhouses, piles of brush, and the like. Larvæ of *A. pulvipennella*, in leaves, folded lengthwise, of *Solidago* and *Eupatorium;* of *A. robiniella*, in similarly folded leaves of locust. Larvæ of *D. cinereocostella* fasten together leaves of water parsnip.

## Blastobasidæ

Smith wrote: "These moths are usually small in size with a peculiar silken sheen to the prevailing gray shade of the forewings. The favorite time for flight is an hour before sundown, when sometimes hundreds can be taken. The larvæ live in seeds, nuts, and buds, as well as Aphid and Kermid galls." And in connection with *Valentinia glandulella:* "Almost every acorn found on the ground in midwinter contains one or more of the larvæ of this species, often in company with a Tortricid and a Coleopterous larva."

## Elachistidæ

**Coleophora**

Quoting Smith again, and most of the short notes which I give concerning moths are culled from his *Insects of New Jersey:* "As many of the species in the adult stage are indistinguishable from each other, the only reliable way to identify them is by breeding. The larvæ are all case-makers, the cases distinctive for each species. In shape they range from slender flattened cylinders to one made of clusters of flowers. Almost every plant supports one or more species, many are confined to grasses, and others live in seed heads. In general, the life histories are similar; eggs are laid in summer, the larva makes a small case in which it hibernates in the next to the last stage. In the earliest days of spring it resumes feeding for a few weeks, moths issuing May to July." The cases may be found during the winter attached to trunks and larger limbs. When the trees leaf out, the larvæ move to the leaves. *C. caryæfoliella*, cylindrical dark brown case on hickory leaves. *C. corylifoliella*, case flattened, with serrate edges, on hazel. *C. fletcherella*, small dark brown flattened case on apple (Plate LXI). *C. laricella*, small dark brown case on larch. *C. limosipennella*, flat case, with serrate upper edge, on elm. *C. maliworella*, black, pistol-shaped case on apple. *C. pruniella*, large black pistol-shaped case on wild cherry. *C. ostryæ*, reddish-brown, flat case on ironwood. *C. querciella*, scimiter-case, anterior two

thirds white, the rest black, on oak. *C. vagans*, grayish cylindrical case on grass. *C. viburnella*, flat brown case with upper edge serrated on *viburnum*.

Larvæ of *Batrachedra salicipomonella*, in Cecidomyid and Tentheredinid galls on willow leaves.

Larvæ of *Antispila cornifoliella* make blotch mines in *Cornus* leaves; of *A. viticordifoliella* make orange-colored blotch mines on wild grape (*Vitis cordifolia*) leaves.

*Coptodisca*. The larvæ are leaf-miners and some, at least, pupate in a case which they cut from the epidermis of a leaf and attach to a tree trunk. *C. lucifluella*, on hickory; *C. ostryæfoliella*, on ironwood; *C. saliciella*, on willow; *C. splendoriferella*, on *Cratægus*, apple, plum, and wild cherry.

Larvæ of *Mompha brevivittella* and *circumscriptella*, in seed-capsules of evening primrose; of *M. eloisella*, in stalks, during winter, of the same plant.

### Tineidæ

Most of the larvæ are leaf-miners, their life being passed in tunnels between the upper and under surfaces of a single leaf, which, however, they usually desert to pupate in a tough cocoon on a twig or on the ground. The shape of the mine, as seen through the leaf, and the kind of leaf it is in are frequently quite characteristic of a given species. The following definitions are taken from Comstock. See also Plate LXII. The long, narrow, and more or less winding mines are described as "linear mines." Some of these are very narrow at their beginning and gradually enlarge, resembling in outline a serpent; frequently the larger end is terminated by a blotch-like enlargement suggesting a head. Such mines are termed "serpentine mines." Other mines that start from a narrow beginning enlarge more rapidly and extend in a more or less regular curve; these are "trumpet mines." The mines of many species are mere disk-like blotches; these are referred to as "blotch mines." In some of the blotch mines the epidermis of one side of the leaf is thrown into a fold by the growth of the leaf; these are "tentiform mines." A "tract mine" is merely a broad linear one. A "com-

munity" mine is one in which there are several larvæ; it is probably formed by several blotch mines running together.

**Stigmella**

These are among the smallest of Lepidoptera, some having a wing expanse of not over an eighth of an inch. *S. amelanchieriella*, broad mines in leaves of June-berry (*Amelanchier*); *S. anguinella*, narrow, serpentine mines in oak leaves; *S. saginella*, moderately broad, serpentine mines in oak and chestnut leaves; *S. caryæfoliella*, very narrow, whitish mines in hickory leaves; *S. corylifoliella*, long, narrow, winding mines in hazel leaves; *S. juglandifoliella*, narrow, whitish mines in walnut leaves; *S. platanella*, large, irregular, blotch mines on under side of sycamore leaves; *S. ostryæfoliella*, moderately wide, tract mines in ironwood leaves; *S. virginiella* long, narrow, track mines in ironwood leaves; *S. platea*, moderately wide, winding mines in oak leaves; *S. pomivorella* mines in apple leaves; *S. prunifoliella*, narrow mines in wild cherry leaves; *S. rosæfoliella*, serpentine mines sweetbrier leaves; *S. rubifoliella*, blotch mines, and *villosella*, narrow linear mines in blackberry leaves.

*Bucculatrix* larvæ are leaf-miners when young but later feed externally. They hibernate in slender cocoons which have longitudinal ribs or ridges and which are usually fastened to the trunks or large limbs of trees.

**Phyllonoryter or Lithocolletis**

All the larvæ are leaf-miners and there are a large number of species. The "samples" given here represent a very small part of the Northeastern fauna, oak, especially, being largely left out of account since it harbors so many of the numerous species which make similar mines. **Oak:** *cincinnatiella* makes large community mines on the under side of leaves; *conglomeratella*, leathery, brown blotch mines on upper side of leaves; *tubiferella*, long, sinuate band-like mines, gradually increasing in width and frequently crossing, on upper side of leaves. **Chestnut:** *macrocarpella*, upper side of leaves (also on oak); *kearfottella*, narrow mines on under side, usually along a vein. **Maple:** *lucidicostella*, on under side;

*saccharella*, irregular blotch mines on upper side; *aceriella*, broad tract mines on upper side of leaves. **Birch:** *betulivora*, small, nearly circular mines on upper side; *lentella*, community mines on upper side of leaves (also on ironwood). **Ironwood:** *obscuriocostella*, under side; *ostryæfoliella*, also on under side but mine is much wrinkled and usually near the margin of the leaf; *tritænianella*, rather large tent mines on upper side of leaves; *ostryarella*, community mines on upper sides of leaves, also on horn-beam. **Locust:** *ostensackenella*, yellow blotch mines on both surfaces of leaves; there are other, more common ones, but they are hard to differentiate. **Hickory:** *caryæfoliella*, upper side of leaves. **Basswood:** *lucetiella* under side; *tiliacella* nearly circular tent mines on upper side of leaves. **Elm:** *argentinotella*, under side; *ulmella*, irregular blotch mines on upper side of leaves. **Poplar:** *salicifoliella*, under side of leaves; this species and others occur on willow; *populiella*, very small tent mine on under side of leaf. **Alder:** *auronitens*, rounded, flattened mines on under side of leaves. **Hazel:** *corylisella*, blotch mines on upper side of leaves. **Witch-hazel:** *hamamelis*, whitish blotch mine on upper side of leaves. **Apple:** *malimalifoliella*, small, much wrinkled, tent mine on the under side of leaves; there are others. **Honeysuckle** (*Lonicera*)*: fragilella*, under side of leaves. **Poison Ivy:** *guttifinitella*, upper side of leaves. This very incomplete list of a single genus might well give us many humble thoughts. What a world of creatures, each as important in its way as we in ours, and each doing its appointed task in the appointed way!

Larvæ of *Gracilaria* are all leaf-miners when young; some leave the mines when half-grown and form cones by twisting and rolling the end of a leaf.

Larvæ of *Parectopa lespedezæfoliella* mine leaves of bush clover (*Lespedeza*).

The larvæ of *Ornix* turn over the edge of a leaf, forming a flap, three or four often being present on one leaf; the cocoon is spun on the ground and the imago does not issue until the following spring. *O. guttea* (abundant) and *solitariella*, on apple; *kalmiella*, on sheep laurel (*Kalmia*)*; preciosella*, on swamp huckleberry; *cratægifoliella*, on

black thorn; *conspicuella*, on birch; *prunivorella*, on wild cherry; *quadripunctella*, on chokecherry.

Larvæ of *Mamara salictella* mine long lines in the tender inner bark of young willows.

Larvæ of *Proleucoptera smilaciella* make blotch mines in leaves of cat-brier (Smilax); pupæ in hammock-like cocoons on under side of leaves.

The larvæ of the following species of *Phyllocnistis* make long, winding, thread-like mines in leaves: *ampelopsiella*, of Virginia creeper; *vitifoliella*, of grape; *liriodendrella*, of tulip poplar.

Larvæ of *Tischeria citripennella* make trumpet-shaped mines in oak leaves; *quercitella*, dentate mines on upper side of oak leaves; *solidaginifoliella* mine goldenrod leaves; *malifoliella* make yellowish-brown blotch mines in apple leaves; *ænea*, funnel-shaped blotch mines in blackberry leaves.

The larvæ of *Setomorpha insectella*, an almost cosmopolitan species, feed on hair and other dry animal products, but, in America at least, do not often become injurious in houses.

Larvæ of *Xylesthia pruniramiella*, in woody excrescences on plum trees.

The larvæ of *Tinea* feed on rotten wood, fungi, dry animal products, and the like. There have been more than a dozen species recorded from New Jersey alone, although the adults have very secretive habits. The following species is well known and widely distributed:

There are three species of Clothes-moths (see also Buffalo-bugs), each belonging to a different genus but all are Tineids and all are Old World species which have long been associated with man, "corrupting" his treasures:

**Tinea pellionella**

*Tinea pellionella* (Plate LXII) has a case-making larva, the case being cylindrical, about as long as the larva. Herrick writes: "The young larva, of course, soon finds its case too small and, as it grows, it has to enlarge the case from time to time. This enlargement is done in a very interesting manner. Without emerging from its case, the larva cuts a slit halfway down one side, thus forming a triangular

opening. Into this opening it inserts a triangular gore of the woolen material upon which it is feeding. This process is repeated on the opposite side of the case and without leaving its retreat it turns around and repeats the same thing on the other half of the case. Thus the case is enlarged in diameter, but it remains for the larva to lengthen its home. This is done by additions to each end of the case. On the outside the case appears to be composed of fibers of the material upon which the larva has been feeding, but inside the case is lined with a soft layer of fine silk. By transferring the larva to different colored materials a curiously parti-colored case may be obtained, for the insect will use the various materials for the enlargements. The larva completes its growth by fall and seeks a secluded place in which to secrete itself and spend the winter in a torpid condition. The larvæ have been observed to leave the carpets upon which they were feeding and drag their cases up a wall fifteen feet high and fasten them to the ceiling. In the spring, the larvæ transform to pupæ in the cases within which they have lived during the winter." About three weeks later the moths emerge. They have a wing expanse of about half an inch; the front wings are shining, yellowish brown, with indistinct dark spots; the hind wings are lighter and plain; both pairs are fringed with long hairs. The second species, *Tineola biselliella*, has a webbing larva; it makes no case but feeds, naked, usually in a fold or crevice of the material it is eating and often under the web of silk which it spins wherever it goes. The cocoon is an irregular affair of silk and food material, somewhat resembling the case of *pellionella*. The adult is about the size of *pellionella;* the front wings are yellower and without spots; the hind wings are pale. The third species, *Trichophaga tapetzella*, is, as yet, rather rare in America. Mr. Wm. T. Davis has bred it from larvæ in barn-owl pellets, but the larvæ are usually found in fur robes, horse-blankets, upholstering of carriages, and the like. It is not so domestic as the other two species. The larvæ burrow into their food-material, making silk-lined galleries, within which they eventually

**Tineola biselliella**

**Trichophaga tapetzella**

pupate. The adults have a wing expanse of about three-quarters of an inch; the bases of the front wings are black, the rest being white, clouded with gray; the hind wings are light gray; the head bears long white hairs. The larvæ of all three species feed on hair, wool, feathers, and almost any fabric of animal origin except (?) silk.

Larvæ of *Prodoxus intermedius* bore in stalks of *Yucca* in great numbers.

**Pronuba yuccasella**

"No discovery in recent years has been more interesting to students of insect and plant life than that which was made in 1872 by Professor Riley, of the intimate relationship which subsists between the beautiful plants, known as Yuccas, and the genus of moths to which the present species belongs. It has been ascertained that the fructification of the various species of Yucca is almost absolutely dependent upon the agency of the female moth; and, strangely enough, it has also been ascertained that the pollination of the flowers is not the result of mere accidental attribution of the wings and other organs of the insect when engaged in seeking for nectar in the flower and when engaged in laying her eggs, but that she deliberately collects the pollen with her mouth, which is peculiarly modified to enable her to do this, and then applies the pollen to the stigma with infinitely better care than it could be done by the most skillful horticulturist using the most delicate human appliances" (Holland) The moth's actions are not altogether altruistic for she lays her eggs in the seed capsules and her young feed on the tissue, which would not develop if she did not pollinate. When full-grown, the larva crawls out and hibernates in a tough cocoon on or in the ground, pupating when spring comes.

The HEPIALIDÆ, Ghost-moths, and MICROPTERYGIDÆ, belonging to the suborder MICROPTERYGOIDEA, contain small, rare moths closely related to the Trichoptera, Caddice-flies; see p. 57. The larvæ of some, at least, of the Hepialidæ bore in roots; those of Micropterygidæ are usually leaf-miners.

## DIPTERA

Members of this order are Mosquitoes, Gnats, and Flies. The last name is applied, with modifying adjectives, to many other insects, but true flies never have more than one pair of wings. The pair of small, knobbed organs, called balancers or halteres, just back of these wings, represents a second pair of wings. The scale-like affairs above the halteres and back of the roots of the wings are called *squamæ* or calyptræ (some authors call them tegulæ or alulæ); there may be two pairs, one pair, or none. Eggs of Diptera are sometimes called "nits"; the larvæ are called "maggots," "wrigglers," or "bots." Pupation often occurs inside the larval skin. About 10,000 species are already described from North America.

The venation of the wings and the arrangement of the thoracic bristles are important in classification; also the antennæ, which vary greatly from group to group. Unfortunately there are several systems of names for the veins and cells of the wings but the following (see Plate LXIX) is in rather general use. The vein which forms the front margin of, and runs for a variable distance around, the wing is called the *costal* (or *marginal*). The next vein back of it is the *auxiliary;* then come the *longitudinals* (first to fifth), the last three of which are often branched. The cell between the costal and auxiliary veins is the *costal cell;* that between the auxiliary and first longitudinal veins is the *subcostal cell;* then, in order along the margin of the wing, are the *marginal*, *first submarginal*, *second submarginal* (between branches of the third longitudinal vein, if branched), and the more or less numerous *posterior cells*. The central cell is the *discal;* and at the base, from front to back, are the *first basal*, *second basal*, *anal* (not always present), and *axillary* cells. A cell is said to be complete when it is entirely enclosed by veins.

I do not expect that this brief discussion will satisfy the reader who attempts to apply it to all Diptera; such special students should go to special books such as Williston's *Manual of North American Diptera.*

Some Diptera have thread-like or feathery antennæ with numerous similar joints; others, such as the ordinary house-flies, have stubby antennæ with only three joints, the third bearing an *arista.* This arista may be bristle-like and either feathered or plain; placed dorsally or at the tip of the third joint. If it is at the tip and is relatively stout, it is called a *style.* The forms of antennæ are numerous and varied. The space between the eyes and above the roots of the antennæ is called the *front.* The *vertex* is the top of the head between the eyes.

The various parts of the thorax have been named and are often important taxonomically. Plate LXIX shows the *achrostical* (*a.*) and *dorsocentral* (*d. c.*) series of bristles divided by the *transverse suture* (*t. s.*). The letter *a.* is placed on the scutellum.

The following key divides ordinary flies into two suborders: Nematocera and Brachycera. Another way of dividing the order is as follows: those flies whose larvæ have a differentiated head, and whose adults leave the surrounding pupal covering through a T-shaped opening on the back of the anterior end, or rarely in a transverse rent between the eighth and ninth abdominal rings, belong to the suborder ORTHORRHAPHA; those flies whose larvæ do not have a differentiated head, whose pupæ are enclosed in the hardened larval skin (forming the so-called puparium), and whose adults leave from the anterior end through a circular orifice (the adults have an oval or crescentic space, the "frontal lunule," above the roots of the antennæ, and usually have a "ptilinum," an inflatable organ capable of being thrust out just above the roots of the antennæ which is used by the adult in springing off the cap of the puparium), belong to the suborder CYCLORRHAPHA. All Nematocera are Orthorrhapha and so also are all Stratiomyidæ, Tabanidæ, Leptidæ, Asilidæ, Bombyliidæ, Dolichopodidæ, and their near relatives among the Brachycera.

## Key to the Families of Diptera (adults)

1. **Flies** of a leathery or horny structure, living as permanent, blood-sucking parasites upon warm-blooded vertebrates; the young (larvæ) are born when nearly ready to pupate. Wings very often reduced or lacking. .....PUPIPARA (p. 279).

**Flies** of a softer structure, not living as permanent parasites upon warm-blooded vertebrates in the adult condition; egg-laying, rarely giving birth to hatched larvæ. Wings very rarely reduced or absent.....2.

2. **Antennæ** having numerous joints freely articulated with each other (usually from 8 to 16). Wings usually without discal cell; the anal cell rarely narrowed in the border of the wing. Palpi as a rule with 4 to 5 joints. Suborder NEMATOCERA .....3.

**Antennæ** are usually composed of 3 joints, usually with a differentiated style or bristle (the last joint sometimes annulated). Wings almost always with a discal cell; the anal cell, if present, closed or much narrowed in the border of the wing. Palpi never with more than 2 joints. Suborder BRACHYCERA.....13.

3. **Wings** with a spider-web-like secondary venation of creased lines between the ordinary veins; slender, long-legged species.....Blepharoceridæ (p. 246).

**Only** the ordinary venation in the wings.....4.

4. **Mesonotum** divided into an anterior and a posterior part by a more or less distinct transverse suture, which is very often V-shaped. Legs very long and slender; body and wings elongate, the wings sometimes with a discal cell. Never small; often very large.....Tipulidæ (p. 236).

**Mesonotum** not divided by a transverse suture. Never very large, often small.....5.

5. **A** complete discal cell present; the costal vein much thinned beyond the tip of the wing; wings usually spotted. Medium sized, mosquito-like.....Rhyphidæ.

**No discal cell**.....6.

6. **Wings** almost always hairy, with only a few longitudinal veins (as a rule 3, rarely 5), very often without apparent cross-veins. Antennæ long and slender.....ITONIDIDÆ (p. 242).

**Wings** always with more than 3 longitudinal veins and, as a rule, with apparent cross-veins. In doubtful cases there are either more than 5 longitudinal veins or else the antennæ are rather stout, shorter than the thorax.....7.

7. **At** least 9 veins reach the margin of the wings, the second and fourth longitudinal veins being forked; costal vein continuing all around the wing.....8.

**Less** than 9 veins terminate in the margin of the wing; the veins never very hairy or scaly.....10.

8. **Veins** bare; second longitudinal veins strongly arched forward.....DIXIDÆ (p. 236).

**Veins** including the hind margin, and also body, very hairy or scaly.....9.

9. **Wings** ovate or pointed, with numerous longitudinal veins and without apparent cross-veins. Small or minute, moth-like flies; the wings, when at rest, held like a roof above the abdomen.....PSYCHODIDÆ (p. 236).

**Wings** elongate, narrow, not held roof-like against the body, with the anterior cross-vein near the middle of the wing distinct.....CULICIDÆ (p. 238).

10. **Antennæ** as a rule shorter than the thorax, rather stout, without constrictions between the joints. Body often stout, not mosquito-like.....11.

**Antennæ** long and slender, the joints longer than broad. Second basal cell usually open (posterior cross-vein wanting). Body slender, mosquito-like.....12.

11. **Second** basal cell usually closed by a cross-vein. Often medium sized.....BIBIONIDÆ (p. 243).

**Second** basal cell open (or wanting). Never more than .25 in. long, with large and broad wings. SIMULIIDÆ (p. 243).

12. **Coxæ,** as a rule, much elongate. All the tibiæ with apical spurs. Ocelli, as a rule, present. MYCETOPHILIDÆ (p. 242).

**Coxæ** at most moderately long. Tibiæ usually without apical spurs. Ocelli absent.....CHIRONOMIDÆ (p. 241).

13. **Antennæ** apparently two-jointed, with a three-jointed arista. Wings (rarely wanting) with strong anterior and much lighter posterior longitudinal veins, usually without discal cell. Small, hunchbacked, quick-running, bristly flies.....PHORIDÆ (p. 253).

**Antennæ** almost invariably with 3 easily distinguishable joints, the terminal one being often annulated. Discal cell, as a rule, present.....14.

14. **Three** nearly equal pulvilliform pads under the tarsal claws. Head and thorax without strong bristles.....15.

**Only** two pads under the tarsal claws, the median one wanting or represented by a bristly hair. Head and thorax often with bristles.....19.

15. **Squamæ** very large; thorax and abdomen inflated; head small, with relatively large eyes.....CYRTIDÆ (p. 248).

**Squamæ** of moderate size or small, or the thorax and abdomen not inflated.....16.

16. **Third** joint of the antennæ simple, not composed of superficial rings. Costa enclosing the wing margin beyond the tip. Squamæ very small, vestigial.....LEPTIDÆ (p. 248).

**Third** joint of the antennæ complex, 4- to 8-ringed, rarely with a distinct bristle-like arista.....17.

17. **Costal** vein not enclosing the hind margin of the wing. Squamæ small or vestigial.....STRATIOMYIDÆ (p. 246).

**Costal** vein continuing around the hind margin of the wing.....18.

18. **Squamæ** conspicuous.....TABANIDÆ (p. 247).

**Squamæ** small or vestigial.....XYLOPHAGIDÆ.

19. **Third** longitudinal vein forked, delimiting two or more submarginal cells.....20.

**Third** longitudinal vein not forked, but one submarginal cell.....25.

20. **Anal** cell, when present, closed some distance from the hind border of the wing, sometimes absent. Third antennal joint usually with a terminal style. Vertex flat or convex.....EMPIDIDÆ (p. 252).

**Anal** cell always present, either open or closed in or near the margin of the wing.....21.

21. **Vertex** flat or convex, the eyes not bulging; in the males the eyes often contiguous.....22.

**Vertex** sunken, distinctly hollowed out between the eyes, which are never contiguous in the males. Mostly large flies.....24.

22. **Fourth** longitudinal vein terminating at or before the tip of the wing. Three posterior cells. Proboscis hidden. Antennæ without a style or bristle. Flies of moderate or small size, bare or scaly..... SCENOPINIDÆ (p. 250).

**Fourth** longitudinal vein terminating beyond the tip of the wing. Antennæ often with a terminal style. Body usually bristly or pilose, sometimes of large size. Proboscis projecting.....23.

23. **Five** posterior cells in the wing. Abdomen rather long and tapering. Proboscis moderately long..... ..... THEREVIDÆ (p. 250).

**As** a rule, 4 or 3 posterior cells in the wing. Abdomen usually stout, broad, hairy, rarely very slender and bare. Proboscis often very long.....BOMBYLIIDÆ (p. 250).

24. **Body** without bristles. Proboscis with fleshy labella at tip. Venation of the wing complicated, the fourth longitudinal vein curves forward to terminate in front of the wing-tip.....MYDAIDÆ (p. 251).

**Body** bristly. Proboscis horny and rigid, without fleshy labella at tip. Venation of the normal type.... .....ASILIDÆ (p. 251).

25. **Wings** pointed; no cross-veins except at the base; second longitudinal vein ending almost at the tip of the wing. Length, less than .2 in.....LONCHOPTERIDÆ.

**Wings** rounded at the tip, the second longitudinal vein ending before the tip of the wing; cross-veins present. .....26.

26. **Anal** cell, when present, short, closed some distance from the hind border of the wing, sometimes absent.....27.

**Anal** cell elongate, acute, either open or closed toward or near the border of the wing. Second basal cell as a rule separated by a cross-vein from a complete discal cell .....29.

27. **Frontal** lunule and suture (ptilinum) almost always distinct. Head and thorax very often with bristles. Third antennal joint usually with dorsal arista. Second basal cell as a rule separated by a cross-vein from a complete discal cell. Numerous Muscoid families. See p. 258 and following pages.

**No** frontal suture. Second basal cell often confluent with the discal cell, or the discal cell absent. Usually small flies ..... 28.

28. **For** the most part brilliantly colored (metallic green) flies. Arista of the antennæ dorsal or terminal. Second basal cell merged with the discal cell..... DOLICHOPODIDÆ (p. 251).

**Color** not brilliantly green. Arista of the antennæ usually terminal. Second basal cell rarely merged with the discal cell..... EMPIDIDÆ (20).

29. **Between** the third and fourth longitudinal veins and subparallel with them a spurious longitudinal vein, which is rarely absent. Usually brightly colored flower-flies, rarely with bristles..... SYRPHIDÆ (p. 253).

**No** extra vein between the third and fourth longitudinal veins..... 30.

30. **Proboscis** elongate and slender, often folding. No bristles on head and thorax..... CONOPIDÆ (p. 257).

**Proboscis** short, not projecting. Small flies..... 31.

31. **Antennæ** with terminal arista. Head and thorax with bristles..... PLATYPEZIDÆ.

**Antennæ** with dorsal arista. Head and thorax without true bristles. Wings much longer than the abdomen. ..... PIPUNCULIDÆ.

## NEMATOCERA

### Tipulidæ

These are the Crane-flies or Daddy Long-legs—those who complain

> "My six long legs, all here and there,
> Oppress my bosom with despair."

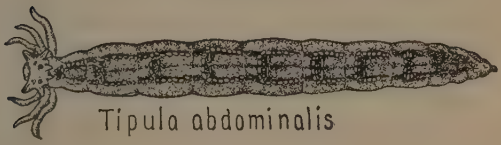
The long legs and the V-shaped suture between the wings usually distinguish this family from other true flies. They are sometimes mistaken for mosquitoes and the large ones—some are over two inches long—are blamed on New Jersey; but they do not bite. I cannot tell you how to keep the legs on your specimens. *Chionea valga* is wingless and is found in northern United States crawling about over the snow. *Bittacomorpha clavipes* has black legs with white bands; its larva lives in shallow, debris-clogged water. The larva of *Tipula abdominalis* (Plate LXIII) is also aquatic. The aquatic larvæ are both vegetarians and carnivors. Tipulid larvæ are sometimes called "leather jackets" and many of them are found in decaying vegetation on dry land; others under bark and in fungi; some feed, at least incidentally, on roots; and a few, such as *Cylindrotoma*, on the leaves of violets, anemones, and other terrestrial plants. The pupæ are slim affairs with relatively short wing-cases.

### Psychodidæ

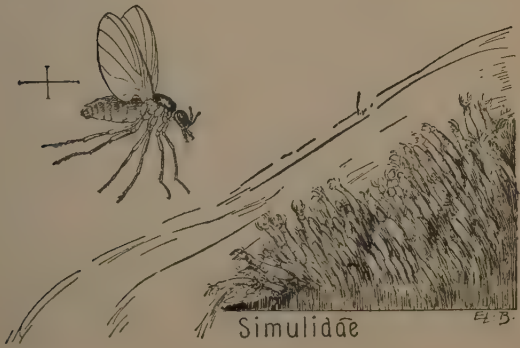
These thickly haired Moth Flies are rarely more than a sixth of an inch long. They fly but weakly in shady places, on windows, and in outhouses; and are often abundant at lights. Their larvæ live in decaying vegetation, in dung, and in water.

### Dixidæ

Rather long-legged, nearly hairless flies. The larvæ are aquatic and resemble those of mosquitoes. The adults are usually found about moist places in forests, sometimes dancing in swarms.



Tipula abdominalis



Simulidae

## CULICIDÆ

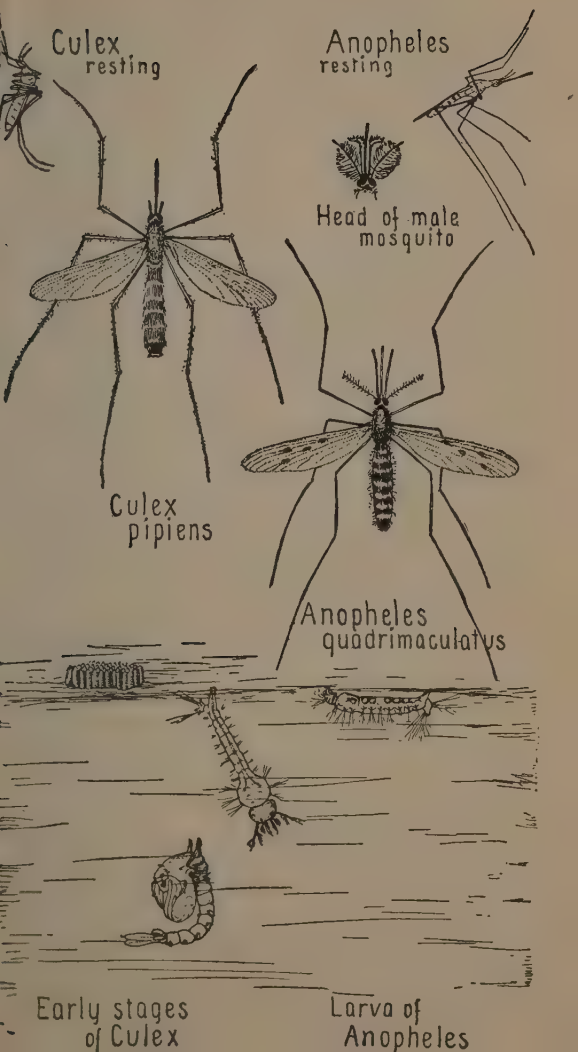
Everyone knows a Mosquito, or thinks he does. The proboscis of the female is fitted for sucking but the mouth-parts of the male are rudimentary (he cannot "bite") and his antennæ are very plumose. The veins of a mosquito's wings are scaly, as is also the body. The larvæ are aquatic; they are the "wrigglers" such as most of us have seen in rain barrels. Owing to the interest in mosquitoes by reason of their connection with malaria and yellow fever, they have been extensively studied and many genera and species have been described. For most purposes we, in the North, can stick to the old division into two principal genera, *Anopheles* and *Culex*. See Plate LXIV.

**Anopheles**

The palpi of the adult female are nearly as long as the proboscis, so that her beak appears to be three-pronged (do not mix in the antennæ). Possibly other species carry malaria but the only United States species which has been definitely convicted is *quadrimaculatus* (*maculipennis* of some authors). Plate LXIV will help you identify it but beware of any three-beaked, spotted-winged mosquito. When properly posed, it holds the body at an angle to the surface upon which it rests, the beak being in the same direction as the body. It may have previously sucked the blood of a malarial patient; the malarial parasite may then have worked its way from the mosquito's "stomach" to its salivary glands and be ready for injection into you. The eggs of *Anopheles* are laid singly in water. The larvæ live among surface vegetation in fresh water, usually where sewage is absent and a slight current prevents stagnation. Larvæ have been reported from brackish water but in my experience those found near salt meadows were in fresh-water pools. They have a short breathing siphon at the hind end of their body and float parallel with the surface of the water. Adults hibernate in sheltered places such as cellars and hollow trees.

**Culex**

Our northern species are harmless, except that the females bite; in fact, they bite harder than *Anopheles* but they do not carry malaria.


Culex
resting
Anopheles
resting
Head of male
mosquito
Culex
pipiens
Anopheles
quadrimaculatus
Early stages
of Culex
Larva of
Anopheles

Yellow fever is transmitted by *calopus*, a tropical and subtropical species of a subgenus, or separate genus, *Aëdes*. This mosquito has also been called *Stegomyia fasciata*. For the most part, the species of *Culex* have unspotted wings; the palpi of the female are short, the beak not appearing to have three nearly equal prongs. The adults usually hold their bodies parallel to the surface on which they rest, the beak being at an angle. The larval breathing siphon is long and the larvæ hang head-down from the water's surface film. The eggs of *Culex*, in a limited sense, such as those of the common, rain-barrel *C. pipiens*, are laid in a floating, raft-like mass. Those of what are now called *Aëdes*, such as the common salt-marsh mosquito with banded legs, *A. sollicitans*, may be laid singly or in little masses in the mud of low ground, or on the surface of the water, sinking to the bottom and usually passing the winter in that stage. The eggs of *A. canadensis* commonly hatch in woodland pools before the weather moderates.

*Wyeomyia smithii* breeds in the leaves of pitcher plants (*Sarracenia*). "Larvæ may be found at all times of the year, the winter being passed in that stage, sometimes active in mild weather, sometimes frozen solid" (Smith). Even the female does not bite.

The pupæ of mosquitoes are humpbacked wrigglers or, rather, "flappers," which breathe by means of a pair of trumpet-shaped siphons on their back. They are active throughout pupal life but do not usually move unless disturbed. The larvæ and pupæ really breathe atmospheric air, for they stick their breathing siphons just out of the water. Kerosene, spread on the water, prevents them from getting to the air, hence they smother. Furthermore, the kerosene may corrode their tissues. However, the best way to combat mosquitoes is to prevent their breeding. Put fish in all pools which cannot readily be drained; keep the edges of streams and ponds sharp so that fish can collect all the eggs, larvæ, and pupæ; drain swamps and useless pools; bury tin cans and the like; and fill up all tree holes. I hope this will never be completely done in my lifetime. I would rather stand a *few* mosquitoes than have all my collecting places for aquatic insects spoiled.

Certain genera are grouped by some good authorities in a separate family, CORETHRIDÆ. The wings and body are covered with hairs instead of scales. The adults look like mosquitoes, but probably do not feed, certainly do not bite; the larvæ are predatory, often cannibalistic, whereas mosquito larvæ are vegetarians; and the larvæ, for the most part, do not breathe atmospheric air but get their oxygen by absorption from the water. These young Corethridæ are called Phantom Larvæ on account of their almost complete transparency. By looking carefully one may see them in still, shaded pools, keeping a horizontal position a little below the surface of the water. The eyes are dark, and there are two pairs of dark spots, one pair on the thorax and one near the end of the abdomen. These are "air-sacs." I do not know how the air gets in there or if it is real air. The pigment in the lining of these sacs may have something to do with it. The pupa floats in an upright position and doubtless gets atmospheric air through the respiratory trumpets on the top of its head.

### CHIRONOMIDÆ

This is a large family of delicate, often minute, flies, commonly known as Midges. The costal vein does not go further than the tip of the wing. "The larvæ are soft-skinned, worm-like, often blood-red in color and usually aquatic, as are also the active pupæ, though some live in decomposing vegetable matter, or in the earth. These midges are often seen, especially in the early spring or in the autumn, in immense swarms, dancing in the air, and have doubtless in many cases given rise to exaggerated stories of mosquitoes. . . . While at rest they usually raise their fore legs in the air and keep them constantly vibrating" (Williston). Most of the adults are harmless, but Sand-flies, Punkies, and No-see-ums, belonging to the genus *Culicoides*, make life miserable. They are the smallest blood-suckers, some of them being only .04 in. long. Some larvæ live under bark and fallen leaves, and in sap flowing from wounded trees. *Chironomus* has many inoffensive species; the larvæ are common in tubes in soft mud.

### Itonididæ (or Cecidomyiidæ)

The layman usually knows these only by their works. Many of them are gall makers (see p. 457) or live in galls made by other species; some breed in decaying wood and bulbs, others under bark and in fungi, while still others feed on plant lice. Unlike most Diptera, many of these pupæ are enclosed in a cocoon formed by an exudation from the larvæ. The genus *Miastor* contains species whose larvæ sometimes develop eggs which hatch, without fertilization, inside their "mothers," the children then devouring their parent.

**Mayetiola destructor**

"Probably no other insect does so widespread damage as the Hessian Fly, attacking our chief staple, wheat, as well as rye and barley. One-tenth of the whole crop, valued at $50,000,000 to $70,000,000, is generally conceded to be destroyed by this pest every year. In certain sections the loss often amounts to from 30 to 50 per cent., and in 1900 was estimated at fully $100,000,000" (Sanderson). It (Plate LXV) is a European insect which was first noticed on Long Island shortly after the Hessian troops landed there. The adults are dark-colored gnats, about .1 in. long. The larvæ imbed themselves in the plant, especially where the stem is covered by a leaf, absorb the sap, and weaken the straw. The "flax-seed" is the puparium.

The Wheat-midge, *Diplosis tritici*, was introduced from Europe a few years after the Hessian Fly. Its larvæ feed on the developing wheat-heads and pupate in underground cocoons. The larvæ of *Dasyneura leguminicola* feed on clover seed. The Pear Midge, *Contarinia pyrivora*, is another immigrant from Europe; it causes a lumpy growth in the fruit, the larvæ working chiefly at the core.

### Mycetophilidæ

The larvæ of these minute Fungus Gnats feed on fungus (including cultivated mushrooms) and decaying vegetation, often living in the soil of potted plants. Many, especially species of *Sciara*, are gregarious and travel in "armies"

when looking for better food or when about to pupate. The larvæ often spin webs and some, at least, pupate in a dense, spun cocoon. Luminous larvæ have been described but their light was probably borrowed from the fungi.

### Bibionidæ

The name March Flies is misleading, as adults rarely appear that early. Some are common about fruit-tree blossoms. The larvæ feed on excrement, decaying roots, and logs. The white-winged, rather long-legged, clumsy fly which frequently occurs in large numbers in meadows and is sometimes seen on windows is *Bibio albipennis* (Plate LXV).

### Simuliidæ

Those who know the Black Flies of the North woods, or the Buffalo Gnats and Turkey Gnats of other sections, know some adult Simulids: stout, hump-backed, short-legged biting pests with very interesting larvæ. See Plate LXIII. The larvæ are black and sit, in colonies, on their tails on rocks, sticks, and leaves in shallow, swift-flowing water. They cling by means of sucker-like hind legs and they also have a front pair, which they use when crawling. Miall's *Aquatic Insects* is a model of scientific accuracy and charming diction. He says: "If seriously alarmed, the larva lets go, and immediately disappears from sight. But by watching the place attentively, we shall before long see the larva working its way back, and in a minute or two it will be found attached to the very same leaf from which it started, or to some other leaf, equally convenient, which it happens to fall in with. I found the difficulties of observation in fast-flowing water crowded with leaves very great, until at last it occurred to me to push a white plate in among the leaves. Then the dark-coloured larvæ became perfectly evident on the white ground, and I was able to see exactly how they managed. When disturbed by the plate, some of them let go, and drift a few inches away. They are not very easily frightened, and most of them remain holding on by their sucker. Those which quit the leaf remain stationary in the torrent or nearly so, and on close observation a thread, or perhaps

a number of threads, become visible on the white ground. These threads are in general stuck all over with small vegetable particles, like fine dust, which make them much more apparent. The threads extend in all directions from leaf to leaf, and the larva has access to a perfect labyrinth, along which it can travel to a fresh place by help of the current and with the speed of lightning. . . . Although the larva commonly slides along a thread previously made, and easily seen to be an old one by the small particles which cling to it, it can upon a sudden emergency spin a new thread, like a spider or a Geometer larva. . . . When the time for pupation comes, special provision has to be made for the peculiar circumstances in which the whole of the aquatic life of the Simulium is passed. An inactive and exposed pupa, like that of Chironomus, may fare well enough on the soft muddy bottom of a slow stream, but such a pupa would be swept away in a moment by the currents in which Simulium is most at home. Before pupation the Insect constructs for itself a kind of nest, not unlike in shape to the nests of some Swallows. This nest is glued fast to the surface of a water-weed. The salivary glands, which furnished the mooring-threads, supply the material of which the nest is composed. Sheltered within this smooth and tapering cocoon, whose pointed tip is directed up-stream, while the open mouth is turned down-stream, the pupa rests securely during the time of its transformation. When the cocoon is first formed, it is completely closed, but, when the Insect has cast the larval skin, one end of the cocoon is knocked off, and the pupa now thrusts the fore-part of its body into the current of water. The respiratory filaments, which project immediately behind the future head, just as in Chironomus, draw a sufficient supply of air from the well-aërated water around. The rings of the abdomen are furnished with a number of projecting hooks, and as the interior of the cocoon is felted by silken threads, the pupa gets a firm grip of its cocoon. If it is forcibly dislodged a number of the silken threads are drawn out from the felted lining.

"A serious difficulty now appears. The fly is a delicate and minute Insect, with gauzy wings. How does it escape

Mayetiola destructor

Bibio albipennis

Stratiomyia discalis

Chrysops niger

C. univittatus

C. vittatus

C. callidus

C. celer

atratus

Tabanus

lasiophthalmus

from the rushing water into the air above, where the remainder of its life has to be passed? . . . During the latter part of the pupal stage, which lasts about a fortnight in all, the pupal skin becomes inflated with air, which is extracted from the water, and passed apparently through the spiracles of the fly into the space immediately within the pupal skin. The pupal skin thus becomes distended with air, and assumes a more rounded shape in consequence. At length it splits along the back, in the way usual among Insects, and there emerges a small bubble of air, which rises quickly to the surface of the water and then bursts. When the bubble bursts, out comes the fly."

The larvæ have, on their heads, brushes which gather up food brought to them by the stream. This New Year's I found them in large numbers where a much-used road crossed a small brook; the automobilists apparently wondered what I was looking for in that cold water, but passed on in ignorance of things far more interesting than so-many miles an hour.

### Blepharoceridæ

The flat, aquatic larvæ cling to stones in swift streams by means of ventral suckers, one to each of the six sections of the body, which are marked off by sharp constrictions. The even flatter, heavily chitinized, shining black or brown pupæ are fastened by three pairs of pads.

## BRACHYCERA

Having omitted several small families, we now reach the flies with thick, few-segmented antennæ.

### Stratiomyidæ

Some of the Soldier Flies are gay with yellow or green and black cross-stripes on their flat, broad abdomens; the abdomen is so wide in some species that it extends on each side of the folded wings. The longitudinal veins are crowded toward the front part of the wings, those which are left in the hind part being much fainter. There are numerous species, their larvæ having various habits.

Aquatic larvæ (such as those of *Stratiomyia*, Plate LXV, and *Odontomyia*, Plate LXVI) have a circlet of bristles on their tails which opens out flat when the larva is at the surface taking atmospheric air into its tracheal system through its tail-spiracles, but which folds together when the larva wishes to free itself from the surface film. Many, or most, of these aquatic larvæ pupate in the mud at the water's edge. Larvæ also occur in cow dung (*Myiochrysa*), in privies (*Hermetia*), under stones, in tree sap (*Geosargus*), in decaying wood (*Pachygaster*), in moss, in catsup, and on vegetables, such as potato tubers and growing lettuce. Some are carnivorous; others are vegetarians. Pupation occurs in the larval skin.

### Tabanidæ

These (Plates LXV and LXVI) are surely of popular interest; they are the Horse Flies, Green-headed Monsters, Gad Flies, Breeze Flies, Ear Flies or Deer Flies. Only the females bite; the males content themselves with sipping sweets from flowers. The predaceous larvæ live in water or in moist earth, apparently hibernating as mature larvæ and pupating, free from the larval skin, the following spring. The somewhat flattened larvæ have a circle of fleshy protuberances around each segment, which aid them in locomotion. There are many species, about forty of *Tabanus* and thirty-five of *Chrysops* having been recorded, for example, from New Jersey. The eyes of the males touch each other above; those of the females are somewhat separated; but those of both sexes, especially of *Chrysops*, are beautifully marked with brilliant colors in life. These colors may often be temporarily restored in dried specimens by moistening with water or glycerine.

1. **Hind** tibiæ with spurs at the tip.....2.
   **Hind** tibiæ without spurs at tip; ocelli absent.....3.

2. **Third** joint of antennæ composed of 5 superficially separated rings, the first of which is much longer than the following ones; ocelli present. *Chrysops* is the common genus. The wings very often have broad, black crossbands. The western *Silvius* is distinguished from it by having the second antennal joint only half as long as the first.

**Third** joint of the antennæ composed of 8 rings, the first of which is only slightly longer than the following ones. *Goniops* (wings dark in front, clear behind; eyes of female acutely angulated above) and *Pangonia* (wings nearly clear or else uniformly darkened; female's eyes not so angulated; proboscis often very long).

3. **Third** joint of antennæ with 4 rings; front of female very wide. Wings darkened and spotted with rings; when at rest, held in a roof-like position..... *Hæmatopota.*

**Third** joint of antennæ with 5 rings and with a distinct basal angle or process above (the southern *Diachlorus* differs in not having this process); front of female not unusually wide. Hind tibiæ without long hairs (such as the western *Snowiella* has)..... *Tabanus.*

### Leptidæ

"These trim-appearing flies [see *Leptis*, Plate LXVII, and *Chrysopila*, Plate LXVI] have rather long legs, a cone-shaped abdomen tapering towards the hind end, and sometimes a downward projecting proboscis, which with the form of the body and legs has suggested the name snipe-flies" (Comstock). They are usually of medium size for flies and are frequently found resting head-down on grass stems and tree trunks. The squamæ are rudimentary; the costal vein surrounds the wing; the antennæ vary greatly from genus to genus but the joints beyond the second are usually more or less fused. The larvæ, which live in decaying wood, under bark, in the burrows of wood-boring insects, in moss, and even in water, are predaceous as are also most of the adults.

### Cyrtidæ

These rarely noticed, small-headed flies have curious habits. You may find *Opsebius pterodontinus* about the webs of the common grass-spider, *Agelena nævis*, and can recognize it by the tooth-like projection on the front margins of the wings. Its larvæ live in the spiders and its relatives have similar habits. The tables are turned; in this case the fly eats the spider.

Odontomyia cincta

Tabanus nigrovittatus

Chrysopila thoracica

Anthrax lateralis

Bombylius major

Psilopodinus patibulatus

Syrphus americanus

Volucella evecta

Bombyliomyia abrupta

Milesia virginiensis

### Bombyliidæ

If you see a fuzzy fly hover in mid-air and suddenly dart a few feet away to hover again, you may feel certain that it is a Bee Fly. That name, and the "real" name for the family is just as bad, has always confused me, as it seemed to go with certain more bee-like Asilids, but it does not. Plate LXVI shows samples of *Bombylius* (larvæ live in the nest of bees, such as *Andrena*) and *Anthrax* (the larvæ of some species of this genus are probably parasites of Lepidoptera but those of others, especially of those whose adults have wing-markings, are parasites of Lepidoptera's parasites); Plate LXVII, of *Spogostylum*, *Systropus*, and *Exoprosopa*. The Bombyliid face is not hollowed out and the eyes, especially of the males, almost or quite touch above; the proboscis has broad tips and is sometimes very long and slender; the wings often have dark markings. The beak is chiefly used to sip nectar. The larvæ feed upon the eggs or young stages of grasshoppers, beetles (e. g. *Cicindela*), Lepidoptera, bees, and wasps.

### Scenopinidæ

We have only one genus, *Scenopinus*, of the Window Flies and, of this, only *fenestralis* (Plate LXVII) is common. It is bluish, with reddish-yellow legs; the head is placed so low that the thorax seems quite convex. It is on our windows because its worm-like larvæ are under our carpets, eating "moths." Each of the larva's abdominal segments, except the last, is constricted, so that it appears to have nineteen segments.

### Therevidæ

The Stiletto Flies are like delicate, long-legged Asilidæ but the front of the head is not hollowed out between the eyes; it may even be convex and the eyes of the males may join on top. Their habits are those of the Asilidæ. *Psilocephala* (Plate LXVII) is a common genus.

### Mydaidæ

This is a small family of large flies which resemble the thin-bodied Asilidæ and have similar habits but whose probosces have fleshy lips at their tips. Only one genus, *Mydas* (Plate LXVII), occurs in the Northeast.

### Asilidæ

In Plate LXVII, *Leptogaster*, *Dasyllis*, *Erax*, and *Asilus* of the large family of Robber Flies are illustrated, the two last-named being the more typical. Some species are two inches long; they are frequently seen swooping upon insect victims in mid-air or snatching them off of leaves and carrying them away to a convenient spot where the sucking of vital fluids may be quietly completed. The hairier and stouter type is just as predaceous and possibly their resemblance to peaceful bumble-bees helps them to get close to their prey, although this mimicking may be a protection against other predaceous animals which fear the bees' sting, or again it may just "happen so." The eyes bulge out so that the head seems to be hollowed between them; the proboscis is stout, rather than long; the legs are strong and bristly. The larvæ, also, are predaceous, feeding upon other larvæ in rotting wood, under bark, fallen leaves, or in loose soil.

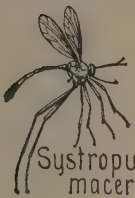
### Dolichopodidæ

A technical point which distinguishes this family is that the discal and second basal cells are united, there being no separating cross-vein. They are usually less than .3 in. long; have slender, tapering, usually metallic green abdomens, and the tarsal part of the long legs are often relatively quite long (See *Psilopodinus*, Plate LXVI). Prof. Aldrich says: "This family perhaps surpasses any other natural group of animals in the variety of secondary sexual characters possessed by the males. These are ornaments, and are paraded before the females, as are similar ornaments in the peacock and turkey-cock. They may occur in the tarsi, tibiæ, femora, wing-apex, face, third joint of antenna, arista, palpi, and still other places. . . . The

Leptis mystacea

Spogostylum simson

Exoprosopa fascipennis



Systropus macer

Psilocephala haemorrhoidalis

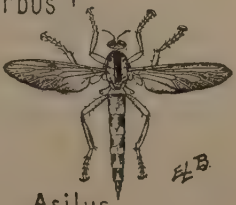
Scenopinus fenestralis

Mydas clavatus

Leptogaster flavipes

Erax rufibarbus

Dasyllis thoracica



Asilus sericeus

larvæ are almost wholly unknown in the United States; several species have been worked out in Europe. They are found in moist earth rich in decaying vegetation, upon which they feed; Dr. A. D. Hopkins has found larvæ of *Medeterus* in burrows of Scolytidæ and thinks them predaceous. . . . In adult life all are predaceous, capturing chiefly the minuter soft-bodied flies, which they enclose within their soft labella [lips], after the manner of *Scatophaga*, while extracting the juices." The most common place for adults is on shaded foliage but the sun is by no means avoided. Wet earth at the edge of water is also favored, while *Hydrophorus* and *Hercostomus* stand on the surface of water. *Thinophilus* is partial to sea beaches. *Neurigona* and *Medeterus* frequent the bark of trees, and *Tachytrechus* old logs.

### Empididæ

A question which one always expects, when out walking with non-entomologists, is "What are those little things dancing in the air?" The only way to answer (truthfully) is to catch some and find out, for they may be Homoptera, Coleoptera, Hymenoptera, Diptera, or even some other order. If Diptera, they may belong to any of a number of families; the Chironomids are great dancers (Williston told of such an immense ball that their wings produced a "noise like that of a distant waterfall, and audible for a considerable distance"), but the Empididæ are called the Dance Flies. "The males of certain species of *Empis* and *Hilara* have the odd habit of blowing out bubbles of a whitish viscid substance which they carry about with them in the air. It is believed that these toy balloons are attractive to the females" (Kellogg).

The species vary in size from .03 to more than .5 in. in length. I do not know of any good "catch characters" by which to recognize members of this family. They and the Dolichopodids have the wings noticeably rounded at the tip and the second longitudinal vein ends considerably before the tip of the wing; the eyes of the males often meet; the first and second segments of the three-jointed antennæ are sometimes so small that they look like a single

segment; the head is more or less spherical and loosely fastened. The body is heavier than that of a Chironomid and almost never metallic like the Dolichopodids; and the legs, especially the first pair, are often curiously modified. The adults are predaceous, as are probably also the larvæ, which live in decaying vegetable matter and in running streams.

### Phoridæ

These minute flies would probably not be noticed unless you were looking for them, although they are sometimes to be found on windows. The life histories are varied, but those of the dwellers in ant-nests are probably the most interesting. *Apocephalus* larvæ live inside the head of an adult ant; the larvæ of *Metopina pachycondylæ* curl themselves around the neck of ant larvæ and share the food which the ants bring to their larvæ.

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We now start the division CYCLORRAPHA (see p. 230); the last of the three joints of the antenna is not ringed or complex and always bears an arista; the third longitudinal wing-vein is never branched, and there are never more than three complete posterior cells.

### Syrphidæ

This family is one of the richest in species of all Diptera. A characteristic of the Syrphids is a "false vein" in the wing between, and more or less parallel to, the third and fourth longitudinal veins. The adults are so frequently seen feeding on nectar and pollen that they are called Flower Flies. Some are almost bare and resemble wasps in appearance and manner of flying; others are hairy and resemble bees, even in the droning or buzzing noise they make; but all are quite harmless.

For the Northeast, at least, the following key will serve to identify most of the common genera, if carefully used.

1. **Antennæ** with a terminal style. First two antennal joints elongated; wasp-like: *Ceria*. These joints short: *Pelecocera* (about .4 in. long; eyes bare ) and *Callicera* (larger; eyes pilose).

**Antennæ** with a dorsal arista.....2.

2. **Marginal** cell of the wings open.....3.

**Marginal** cell of the wings closed or petiolate.....20.

3. **Anterior** cross-vein of the wings distinctly before the middle of the discal cell, almost always perpendicular....4.

**Anterior** cross-vein of the wings near, or beyond, the middle of the discal cell, usually oblique.....15.

4. **Antennæ** longer than the head.....5.

**Antennæ** not longer than the head.....8.

5. **Side-margins** of the thorax yellow. *Chrysotoxum; pubescens* (.5 in. long) frequents low foliage and bases of trees.

**Side-margins** of thorax not yellow.....6.

6. **Face** with a projecting tubercle and wholly or partly yellow. *Paragus;* generally fly low in moist, shady places.

**Margin** of mouth projecting and face wholly black. *Chrysogaster;* frequent on spring flowers.

**Face** without a projecting tubercle and mouth-margin not projecting.....7.

7. **Scutellum** flattened, often with spines or tubercles on its border; a vein stump from the third longitudinal vein in the first posterior cell. *Mixogaster* (abdomen much narrowed at base) and *Microdon* (abdominal base not narrowed). The slug-like larvæ of *Microdon* live in ants' nests.

**Scutellum** without spines; no such vein-stump; less than .5 in. long. *Pipiza;* often hover in front of flowers with exposed nectar, such as buttercup. The larvæ of *radicum* feed on root-lice.

8. **Ground-color** of the face black. Both *Chalcomyia* (scutellum large, nearly square) and *Myiolepta* (scutellum not unusually large, broadest at its base) have the hind femora distinctly thickened. Several genera have the femora but little or not at all thickened; of these the following have a tubercle on the face but the margin of the mouth does not project.....9.

**Ground-color** of the face yellowish.....10.

9. **Facial** orbits separated by a slender parallel groove; metallic green or black flies. *Chilosia;* commonly found, covered with pollen, on spring flowers.

**Face** without orbital grooves; black, with more or less metallic green or blue and with yellowish, reddish or metallic cross-bands on abdomen. Wings not longer than the abdomen: *Pyrophæna*. Wings longer than the abdomen: *Platychirus* (Plate LXVIII; front legs of males with tarsi and end of tibiæ dilated) and *Melanostoma* (these joints slender in both sexes). Common at flowers.

10. **Abdomen** much narrowed toward the base, distinctly club-shaped or spatulate in outline. Hind femora slender: *Baccha;* frequently hover near flowers and tips of branches, especially of pine. Hind femora thickened: *Sphegina* (third joint of antennæ rounded) and *Neoascia* (this joint not rounded).

**Abdomen** oval or slender, not club-shaped or spatulate.....11.

11. **Side-margins** of thorax yellow.....12.

**Side-margins** of thorax not yellow. Abdomen without several definite yellow cross-bands: several not very common genera, including *Leucozona* (thickly pilose; a broad yellow band at base of black abdomen). Abdomen with several definite, yellow cross-bands.....13.

12. **A** median, ashy line on thorax. *Mesogramma* (Plate LXVIII). The larvæ feed on aphids, although those of *polita* are said to feed on corn-pollen.

**No** median ashy line on thorax. *Sphærophoria* (Plate LXVIII; face projecting below) and *Xanthogramma* (face receding).

13. **Hind** femora much thickened. *Syritta.*

**Hind** femora slender. Third longitudinal vein with a distinct bend into the first posterior cell: *Didea.* This vein straight or only gently curved.....14.

14. **Margin** of mouth produced into a long snout...*Rhingia.*

**Margin** of mouth not produced. *Syrphus* (see below).

15. **Arista** plumose.....16.

**Arista** bare or merely pubescent.....17.

16. **Antennæ** elongate, the third joint more than twice as long as wide. *Volucella* (see below).

**Antennæ** short, the third joint not so proportionately long. *Sericomyia.*

17. **Third** longitudinal vein deeply curved into the first posterior cell. Several genera; of which *Helophilus* has thickened hind femora, the face is not protuberant, and the third antennal joint is oval. It has been reared from brackish water as well as from carcasses.

**Third** longitudinal vein only gently curved.....18.

18. **Thorax** with distinct yellow markings other than on the shoulder protuberances. Wasp-like flies of large size.....19.

**Not** so. Numerous genera, some not rare.

19. **Hind** femora with a conical, tooth-like protuberance below, near the outer end; sixth longitudinal vein directed obliquely outward beyond the anal cell. *Spilomyia.*

**Not** so. Antennæ inserted low down, near middle of head's profile; face not longer than the front: *Temnostoma* (Plate LXVIII). Antennæ inserted on a conical process; face much produced downward: *Sphecomyia.*

20. **Third** longitudinal vein deeply bent into the first posterior cell. Hind femora with a sharp, tooth-like projection below, near outer end: *Milesia* (Plate LXVI). Hind femora without such tooth, although sometimes thickened: *Eristalis* (see below).

**Third** longitudinal vein not deeply bent; third antennal joint elongate; arista feathery. *Volucella* (see below).

**Volucella**

*V. evecta* (Plate LXVI) differs from its congeners by being furry. *V. obesa* is brilliant shining green; the wings are spotted at the end of the auxiliary vein and on the cross-veins; lives in and near the Tropics. *V. fasciata* is black with yellow markings on the thorax and three rather broad yellow bands on the abdomen; the wings have indistinct dark bands. Some say that the larvæ of *Volucella* feed on the larvæ of bumble-bees and wasps but probably they are merely scavengers in the nests of these Hymenoptera.

**Eristalis tenax**

About the middle of the 18th Century Réaumur, known also for his thermometer, wrote voluminously, and exceedingly well, on life histories of insects. It was he who called the larva

of *tenax* the Rat-tailed Maggot, a name which has stuck. This creature is extremely interesting but one must be interested in order to enjoy it, for it usually lives in foul water, such as privy vaults and the fluid in decaying carcasses. The yellow and black adults, Drone Flies, resemble honey bees, and it was this which led Ovid, Virgil, and other ancient writers to tell about bees originating from dead animals. Plate LXVIII shows both adult and larva; the larva's tail lengthens and shortens like a telescope so that the tip may reach the surface of the water and the larva breathe atmospheric air through it while feeding on decaying matter under water. Pupation occurs out of the water in the larval skin. This was originally an Old World species but it is now almost cosmopolitan. Other species of the genus have similar habits.

**Syrphus**

These (Plate LXVI) and the other aphid-eating Syrphidæ should be classed among our friends. I have seen ants stop milking their aphid cows to threaten a female *Syrphus*, and the ants even ran from the upper to the under side of the leaf and back again to keep her in sight but always she succeeded finally in depositing a minute egg in the midst of the herd. I do not believe the ants reasoned that here was an enemy of their friends; they were merely naturally pugnacious toward any intruder and, at any rate, they never noticed the eggs, which doubtless hatched, in the course of time, into flat, transversely wrinkled, green larvæ, pointed in front and eyeless, but able to search out the sedentary aphids and to suck their juices.

## Conopidæ

*Physocephala sagittaria* (Plate LXVIII) gives a fair idea of the family; some are even more wasp-like, some less; all are "thick-headed." They feed on nectar and pollen but the female, from time to time, leaves this sweet pastime to lay an egg on some bumble-bee, wasp, or grasshopper. The larval and pupal periods are passed in the abdomen of the host.

The families of CALYPTERATE Diptera are very difficult, even for specialists, but, on account of the importance of some of the Muscidæ, an effort must be made to enable intelligent non-specialists to recognize a few of the species. Differing from ACALYPTERÆ (see p. 274), these flies have well developed squamæ; the auxiliary vein is always distinct throughout; the first longitudinal vein is never very short; the eyes of the males frequently touch; the thorax has a complete transverse suture; and the flies are never very small.

The technical terms, about to be used, are explained on p. 230 and Plate LXIX, except "hypopleura," the space on the side of the thorax above the hind coxæ, and "bucca," the cheeks, below the eyes. It should be remembered that the keys will work only with the flies for which they are intended; if you apply them to some other creature, you will get weird results.

Since it is the Muscidæ which are of principal interest, it should be noted, when at **5**, that *Lucilia sylvarum* has a pair of bristles on the posterior margin of the second abdominal segment but its legs are not noticeably long; when at **6**, the Muscid genus, *Muscina*, may give trouble as the narrowing of the posterior cell is not very pronounced.

1. **Mouth-opening** small; mouth-parts small or vestigial.....ŒSTRIDÆ (p. 259).
   **Mouth-opening** normal; mouth-parts not vestigial.....2.
2. **Hypopleuræ** with a tuft of bristles.....3.
   **No** tuft of bristles on the hypopleuræ.....6.
3. **Antennal** bristle (arista) bare or only slightly pubescent.....TACHINIDÆ (p. 260).
   **Arista** plumose or very distinctly pubescent.....4.
4. **Arista** bare on the distal (outer) half..SARCOPHAGIDÆ (p. 262).
   **Arista** plumose or distinctly pubescent to tip.....5.
5. **Back** of abdomen usually bristly on the anterior part; legs usually long.....DEXIIDÆ (p. 260).
   **No** bristles on front part of back of abdomen; legs not noticeably elongated.....Some MUSCIDÆ (p. 266).

6. **First** posterior cell narrowed in the margin or closed; arista plumose to the tip.....Some MUSCIDÆ (p. 266).

**First** posterior cell very slightly or not at all narrowed; arista may be plumose, pubescent, or bare.....
.....ANTHOMYIDÆ (p. 263).

### ŒSTRIDÆ

These are the Gad Flies, Bot Flies, or Breeze Flies. The adults are moderate or large in size; the eyes are rather small and the lower part of the head is relatively large.

**Gastrophilus**

"One of the most interesting and injurious is the Horse Bot Fly, *Gastrophilus equi*. The female horse bot fly lays from 400 to 500 eggs, all of which may be placed, under favorable circumstances, upon one horse. These eggs are fastened to the hairs, generally of the fore legs, shoulders, or chest. A horse instinctively fears this pest, and it will be seen, if in the pasture, to start and strike with the fore feet, although the cause of its nervousness is not visible. The adult fly is brownish, more or less hairy, looking a little like a small honey bee. It is most skillful in depositing its yellowish eggs, 'nits' we sometimes call them, on the animal's hairs. The moisture and friction which these receive from the animal licking its hair cause them to hatch, and further licking, occasioned possibly by the irritation caused the skin by the presence of the tiny larvæ, carries the maggot into the mouth, whence it finds its way into the horse's stomach, and there completes its larval life, attached to the lining of the stomach, and sometimes so abundant as to completely cover a portion of it. . . . The bots live in the stomach or intestine eight or ten months, moulting twice during that period, and naturally, when numerous, sapping the vitality of the horse. They also cause great irritation by attaching themselves to the lining of the small intestine and rectum. In the spring these bots lose their hold and pass out with droppings, working their way into the soil an inch or two, or into some protected locality; each 'bot' or larva changes to a pupa, lying within a pupal case, from which

the adult fly emerges after about thirty days" (Washburn). A number of other species of this genus live in the stomach of horses and asses.

**Hypoderma**

The Warble-flies of cattle, "whose larvæ are found in small tumors under the skin, also have their eggs swallowed, and the young larvæ may be found in the mouth and œsophagus. But from here they burrow out into the body-tissues of the host, finally coming to rest underneath the skin along the back. When the larva or grub is full-grown it gnaws through the skin, drops to the ground, pupates, and in from three to six weeks changes to the adult fly. The hides of cattle attacked by these flies are rendered nearly valueless by the holes, and are known as 'grubby' hides. Osborn estimates that these warble-flies, of which we have two species, *Hypoderma bovis* and *H. lineata*, cause a loss of $50,000,000 annually in this country" (Kellogg).

*Œstrus ovis* is the sheep-bot. Its larvæ live in the nasal and other head passages of sheep, causing the disease known as staggers, grub-in-the-head, or false gid. The larvæ found in the throats of deer are those of *Cephenomyia abdominalis*. Our largest species in the East, and probably our heaviest Dipteron, is *Cuterebra buccata* (Plate LXVIII), whose larvæ are found under the skin of rabbits.

### Dexiidæ

"In habits and life histories, the Dexiidæ closely resemble the Tachinidæ, and the distinction between the two families is very difficult to make, if it is not actually evanescent" (Williston).

### Tachinidæ

This is a family concerning which, from the human viewpoint, nothing but good can be seen; but the taxonomy is difficult and the difficulties are being greatly increased by certain workers who found not only new species but even genera on intangible differences. Amateur Lepidopterists often raise Tachinids instead of Lepidoptera when they

Platychirus hyperboreus

Mesogramma marginata

Sphœrophoria cylindrica

Eristalis tenax

Temnostoma alternans

Cuterebra buccata

Trichopoda pennipes

Physocephala sagittaria

Latreillimyia bifasciata

Epalpus signiferus

Tetanocera plumosa

Scatophaga stercoraria

Sapromyza philadelphica

work with caterpillars which were hatched afield. Plate LXVIII shows *Latreillimyia bifasciata* and *Epalpus signiferus;* the former is parasitic on various Ceratocampidæ. *Trichopoda pennipes* on the same plate has been bred from the squash-bug, *Anasa*. *Bombyliomyia abrupta* (Plate LXVI) is often seen at the edge of woods and in clearings.

Williston says: "The habits of the mature fly are similar for nearly all the members of the group. They will be found on vegetation, on leaves or flowers, in such places as are frequented by the hosts which they parasitize. Not a few will be caught with the beating net. . . . The larvæ of this group are all parasitic in habit so far as known, and the parasitism is probably confined to the early stages of other insects; and the individual fly is not very particular in the choice of larvæ which she parasitizes. Their usefulness in keeping injurious insects in check is immeasurable. By far the largest number of species are parasitic upon Lepidoptera, of which not less than four hundred have been recorded [many more now]. About seventy species are known to be parasitic upon Hymenoptera, less than forty upon Coleoptera, a score upon Orthoptera, five upon Hemiptera, and as many upon other Diptera."

### Sarcophagidæ

These are popularly called Flesh Flies. The family may be fairly well recognized by the key given on p. 258. To be perfectly frank, I dislike writing about unclean things and will use a short service with this family; besides it is a very difficult group, taxonomically. The Thomas Say Foundation, care of the Academy of Natural Sciences of Philadelphia, has just published a monograph of the family by J. M. Aldrich. It is claimed that 20,000 eggs have been found in the ovaries of a single Sarcophagid. The principal genus is *Sarcophaga* (see Plate LXX). Although most of the Sarcophagidæ justify their scientific name and its English equivalent, the larvæ of others feed on dung and rotting vegetable material. Some larvæ are found under the skin of turtles, others in the stomachs of frogs; while still others are parasitic in snails

and insects. Nasal myiasis in man is due to species of this genus. The eggs frequently hatch in the female's body, so that she lays living larvæ.

### Anthomyidæ

This is a large family of inconspicuously colored, small to moderately large flies. The squamæ are usually of considerable size. The larvæ have four rows of thread-like processes on the segments. The common Radish-worm is the larva of *Anthomyia radicum*. The larva of *Phorbia fusciceps* is a general feeder in roots of cabbage, radish, onions, seed corn, and the like. It is an importation from Europe, first noted in this country in 1856. The common Cabbage-maggot is the larva of *Phorbia brassicæ*, which also attacks cauliflower and radishes. Just as the plants are commencing to make a good growth, they suddenly wilt and die although not cut off as by a Noctuid larva. Old cabbage stumps should not be allowed to stay in the garden, as they harbor late-generation larvæ and overwintering pupæ. A troublesome pest in onion bulbs is the Imported Onion-maggot (*Phorbia cepetorum*), although the native *Phorbia ceparum* does some damage (*Chætopsis ænea* of the Ortalidæ is another onion maggot). The larvæ of *Phorbia rubivora* girdle the inner bark of the tips of young raspberry and blackberry shoots. The larvæ of *Pegomyia vicina* make tortuous mines and large blotches in the leaves of beet and spinach. Pupation takes place in loose soil or under fallen leaves. Chittenden notes that "in many cases infestation can be traced directly to the insect having bred in lambs-quarters and similar weeds." *Ophyra leucostoma* breeds in excrement.

**Homalomyia canicularis**

Especially in May and June this, at first sight, small edition of *Musca domestica* is sometimes abundant in houses. Those who do not know that insects do not grow after getting functional wings believe them to be the young of the larger and more common insect. However, all the veins run without sharp bends to the margins of the wings. The

early spring adults have probably been hibernating in the house. The larvæ of the Lesser House-fly live in waste vegetable matter, in the manure of different animals, and especially in human excrement. They have also been found in yellow-jacket (*Vespa*) nests where they were probably cleaning up the debris.

### Muscidæ

Insect pests, as well as diseases, were formerly taken very much as matters of course. Indeed, some people went further and gave reasons why they should be considered blessings exceedingly well disguised. We have long since started to fight all diseases by all the means we can command and when this fight leads us to certain insects which are the transmitters of these diseases, it is only logical that we should combat those particular insects as well. Although this little book mentions a large number of the insects which injure our persons and pocketbooks, such represent a very small proportion of all insects; they have been given space because they are common and asked about. The best that can be said of common house-flies is that they are scavengers; but they are scavengers which come from their dirty surroundings to our tables without disinfecting themselves. Furthermore, however useful they may have been in the past, we are now able to attend to cleaning up the civilized portions of the world in a more cleanly way than by employing creatures which insist upon tracking the disease-laden dirt over our food and our persons.

According to Dr. L. O. Howard, 22,808 out of 23,087 flies actually captured on fly-paper in dining-rooms were *Musca domestica*. The remaining three hundred, or so, consisted of a number of different species. I have arranged a chart (see p. 265) which shows that the Common House-fly, the Disease-carrying Fly, is the only species which is very abundant both in dining-rooms and on one of several things which we dislike to think of in connection with dining-rooms. "Swat the fly" but, better still, prevent its breeding by doing away with, or screening, all possible breeding places within a mile of your house.

FLIES FOUND IN DINING-ROOMS

| FLIES FOUND ON HUMAN EXCREMENT | VERY ABUNDANT | ABUNDANT | MODERATELY ABUNDANT | RARE |
|---|---|---|---|---|
| Very abundant | *Musca domestica* | | | *Sphærocera subsultans*<br>*Borborus equinus* |
| Abundant | | | *Muscina stabulans* | *Sarcophaga sarraceniæ*<br>*Ophyra leucostoma*<br>*Pseudopyrellia cæsarion*<br>*Myospila meditabunda* |
| Moderately abundant | | *Homalomyia canicularis* | *Lucilia cæsar* | |
| Rare | | | *Drosophila melanogaster*<br>*Stomoxys calcitrans* | *Pollenia rudis*<br>*Calliphora erythrocephala* |

Fifteen genera, including a total of twenty species, have been found within fifty miles of New York City and are so widely distributed that they are to be looked for throughout the United States and, indeed, the whole world. Still another eastern genus (*Protocalliphora*) has the disagreeable habit of breeding in nestling birds, causing their death. It is hoped that the following key, taken in connection with the descriptions and figures, will enable the careful student to identify the common species.

1. **Proboscis** long, slender, horny, adapted for piercing . . 2.
**Proboscis** not so, having fleshy labellæ ("lips") at the tip . . . . . 3.
2. **Dark** ash-gray, with a faint tinge of yellow; thorax and abdomen with no distinct markings; not larger than *Musca domestica;* palpi nearly as long as the proboscis . . . . . *Hæmatobia irritans.*
**Palpi** much shorter than the proboscis . . . . . *Stomoxys calcitrans.*
3. **Thorax** with a fairly distinct median dark stripe. (When the stripe is very faint try 15) . . . . . 4.
**Thorax** with the median stripe light, or thorax with no distinct stripes . . . . . 6.
4. **Abdomen** non-metallic in color, spotted or maculated . . . . . *Graphomyia maculata.*
**Abdomen** metallic blue or green; not maculated . . . . . 5.
5. **Face** light yellow; thorax metallic, stripes very distinct . . . . . *Chrysomyia macellaria.*
**Face** reddish-brown; thorax non-metallic; stripes rather indistinct . . . . . *Cynomyia cadaverina.*
6. **Abdomen** opaque brown, a pair of triangular black spots on each of the second and third abdominal segments of the male. These spots are faint or wanting in the female . . . . . *Myospila meditabunda.*
**Abdomen** not marked in this way . . . . . 7.
7. **The** 4th longitudinal vein slightly bent . . . . . 8.
**The** 4th longitudinal vein sharply bent . . . . . 10.
8. **First** posterior cell narrowly contracted at the margin; bluish-black, shining; the tip of the scutellum not reddish; the median light stripe on the thorax more distinct than the others . . . . . *Morellia micans.*

**First** posterior cell scarcely contracted at the margin; black, not shining; tip of scutellum reddish ..... 9.

9. **Legs** and palpi wholly black ..... *Muscina assimilis.*

**Legs** and palpi partly or wholly yellow ..... *Muscina stabulans.*

10. **Abdomen** non-metallic ..... 11.

**Abdomen** metallic ..... 12.

11. **Thorax** without distinct stripes and usually covered with a yellowish "dust"; more than two pairs of acrostical bristles; two anterior and three posterior dorso-centrals. *Pollenia rudis.*

**Thorax** with distinct stripes only in front, if at all; not more than two pairs of acrostical bristles; two anterior and four posterior dorso-centrals ... *Myospila meditabunda.*

**Thorax** with four stripes; not more than two pairs of acrostical bristles; three anterior and four posterior dorso-centrals ..... *Musca domestica.*

12. **Metallic** between the eyes; a prominent bristle on inner surface of each middle tibia ... *Pseudopyrellia cæsarion.*

**Not** so ..... 13.

13. **Abdomen** grayish ..... *Polienia rudis.*

**Abdomen** greenish or bluish ..... 14.

14. **Thorax** not metallic; no spines on the 3rd longitudinal vein except at its junction with the 2nd ..... 15.

**Thorax** and abdomen bright metallic blue or green; spines on the first section of the 3rd longitudinal vein. . . 17.

15. **Distal** third of arista naked; bucca ("cheeks") red in front, black behind ..... *Cynomyia cadaverina.*

**Distal** third of arista bearing some hairs; bucca unicolorous. *Calliphora* ..... 16.

16. **Bucca** black, beard red ..... *C. vomitoria.*

**Bucca** brownish or reddish, beard black ..... *C. erythrocephala.*

**Bucca** black, beard black ..... *C. viridescens.*

17. **Two** stout bristles on dorsal posterior margin of the 2nd abdominal segment ..... *Lucilia sylvarum.*

**Not** so ..... 18.

18. **Acrostical** bristles in front of the transverse suture wanting or feebly developed ..... 19.

**Acrostical** bristles in front of the transverse suture well developed ..... 20.

19. **Posterior** acrosticals feebly developed; thorax somewhat flattened between the suture and the scutellum; usually bluish-black; squamæ brownish..... *Protophormia terræ-novæ.*

**Posterior** acrosticals moderately developed; thorax not flattened; dark greenish or bluish; squamæ whitish. *Phormia regina.*

20. **Having** two posterior acrosticals; greenish or bluish..... *Lucilia cæsar.*

**Having** three posterior acrosticals; greenish or bronzy, rarely bluish..... *Lucilia serricata.*

**Hæmatobia irritans**

Plate LXIX. The name Texas Fly was based on the supposition that this species originated in the West. It came from Europe to the vicinity of Philadelphia about 1887 and is now found from Canada to the Gulf and at least as far west as Idaho. It was formerly abundant in the East but is now quite rare. The name Horn-fly comes from the habit which the adults have of clustering about the base of the horns of cattle to suck blood. The larvæ live in cow dung.

**Stomoxys calcitrans**

The figure (Plate LXX) and the piercing mouth parts of the Biting House-fly make identification easy. Hough says that specimens taken on the borders of woods often have brownish wings. Their superficial resemblance to *M. domestica* and their biting habits have given rise to the error that the latter species is adding to its many sins by sucking blood. Both sexes suck blood. On account of *calcitrans* being more troublesome during rains, it is sometimes called the Storm-fly. Another common name is Stable-fly. It has recently been accused of carrying infantile paralysis. The larvæ feed on a wide range of decaying matter, including fermenting grass cut from lawns, horse manure, and human excrement. It is world-wide in its distribution.

Cynomyia cadaverina

Graphomyia maculata

Pseudopyrellia caesarion

Pollenia rudis

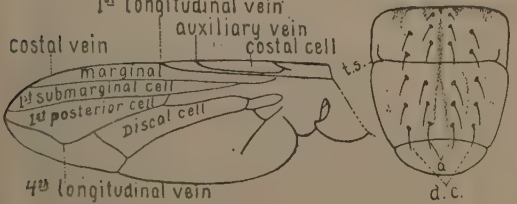
Phormia regina

Muscina stabulans

Haematobia irritans

Morellia micans

Myospila meditabunda



**Graphomyia maculata**

Plate LXIX. The squamæ are slightly dusky. Some, at least, American specimens lack the yellowish color which has been recorded for the European ones on the scutellum. The larvæ are said to live in excrement.

**Chrysomyia macellaria**

This species (Plate LXX) varies from .25 to .50 in. in length. The normal food of the larvæ is carrion. Pupation usually occurs in earth or moist debris. The mature larva is .75 in. long and is provided with a ring of bristles between each pair of segments. These and its pointed shape make it somewhat resemble a screw, hence the common name, Screw-worm. They occasionally feed on living animals, including man, the eggs being laid in open wounds or in the nose. In the latter case, the larvæ work their way into the cavities of the head and sometimes cause death.

**Cynomyia cadaverina**

Adults (Plate LXIX) range from .25 to .50 in. in length. The thorax is slaty-black, with indistinct stripes on the anterior portion. It is very difficult to cite good characters for separating this insect from *Calliphora*. However, common species of *Calliphora* do not usually have markings on the thorax; if they have, the markings are indistinct and not as described for this species. Furthermore, the buccæ of *cadaverina* are grayish-black posteriorly and brown to reddish anteriorly; those of *Calliphora* are usually unicolorous. Although the adults are captured about excrement, it is probable that the larvæ feed exclusively on decaying flesh.

**Myospila meditabunda**

Plate LXIX. The squamæ are yellowish. The larvæ live in excrement. Only a few (several dozen) eggs are laid by each female. The eggs have a black stripe on each side and, as continuations of these, a black curved appendage. This fly is common to both Europe and America.

**Morellia micans**

Except that the tip of the abdomen is brown with a hoary coating, there is little which need be added to the characters given in the key and Plate LXIX. The larvæ breed in excrement, often being abundant in human fæces. The life history is completed in about three weeks.

**Muscina**

Both *stabulans* (Plate LXIX) and *assimilis* are a bit larger and more robust than *M. domestica*. The tip of the scutellum may be reddish. The larvæ feed on excrement and a variety of decaying substances, including fungii and vegetables. *M. stabulans* has been reared from the pupæ of other insects but the pupæ had probably died first, as it is not likely that the species is parasitic. Both species are widely distributed in Europe and America, *stabulans* usually being the commoner.

**Pollenia rudis**

In addition to the characters given in the key and Plate LXIX, it might be said that the space between the eyes is white. On account of its habit of overlapping the wings when at rest, it often appears narrower than *domestica*. The exact date of its introduction from Europe is unknown. It has been bred from manure, but probably only when the manure contained earthworms as it has been bred from these common creatures. The adults are rather sluggish and have been called Cluster-flies from their habit of congregating in masses, especially about the ceilings of rooms. They are looking for a place to hibernate and may find it in closets, behind curtains, or in other nooks. When mashed, these flies are very greasy and have an odor which has been described by some as like honey and by others as "very disagreeable." It is even more susceptible to attack by a fungus (*Empusa*) than is *M. domestica*.

**Musca domestica**

Like most of the Muscidæ, the sexes of the House- or Disease-fly (Plate LXX) may be told apart by the fact that the eyes of the males are nearer together than they are in the females.

The sides of the abdomen of the males are brownish near the base and grayish elsewhere. The females are grayish over all the abdomen with a variable pattern of darker gray or black. It takes the egg about twelve hours, on the average, to hatch. In about five days the larvæ are full-grown and the pupal stage lasts from five days to a month or longer. The puparium is the old larval skin, hardened and brown. Each female usually lays from one to two hundred eggs in the garbage or manure which is the food of the larvæ. Adults may hibernate, but so also do pupæ and larvæ. See *Homalomyia*.

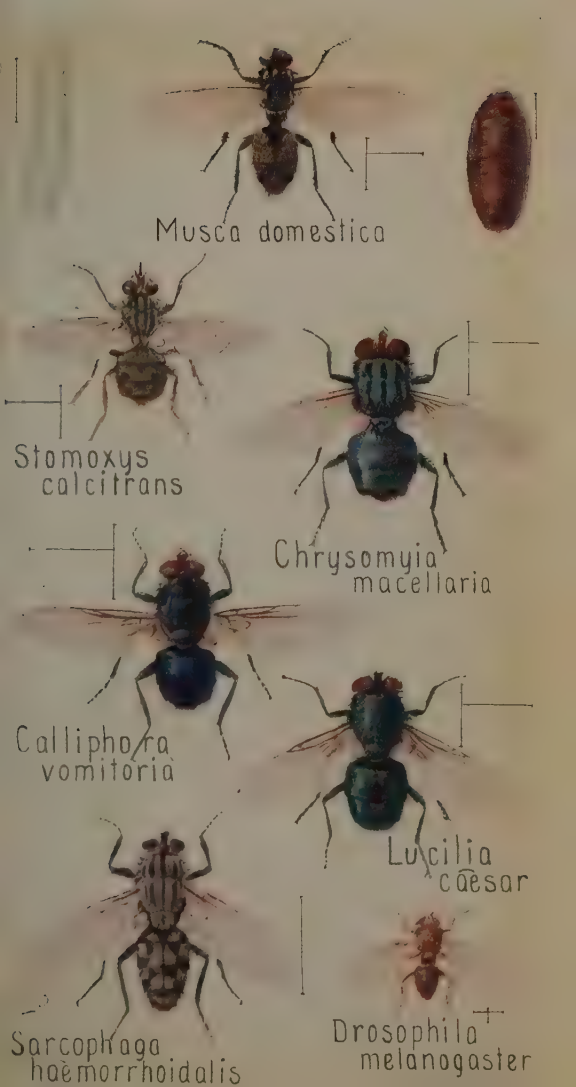
*Pseudopyrellia cæsarion* (Plate LXIX) is easily recognized by the characters given in the key, especially those in couplet 12. The brilliant blue larvæ are often abundant in cow dung.

**Calliphora**

Other flies besides *Calliphora* "blow," that is, lay eggs on meat, but the name Blow-fly is usually applied to members of this genus. The anatomy, physiology, and development of *C. erythrocephala* are very well known, thanks to Lowne's classic work and Portchinski's careful observations. The other two species (see the key and Plate LXX) probably differ but little from it. It lays several hundred small eggs on meat and dead animals. These eggs hatch in about twenty-four hours or less, sometimes even hatching in the female, so that she lays living larvæ. It takes a week or ten days to reach the pupal stage and then about two weeks for adults to emerge. The mature larva may be nearly or quite .75 in. long. Pupation usually takes place under the food-mass or slightly below the surface of the ground. All three species occur also in Europe.

**Lucilia**

*L. sylvarum* is the bluest Blue-bottle; *cæsar* (Plate LXX) is more often greenish; and *sericata* usually has a bronzy gleam, especially on the abdomen. See also *Phormia*, p. 273. Carrion is their chief larval food but *L. cæsar* has been reared from excrement and garbage. The life-histories are completed in from three to four weeks and are about equally divided between larval and pupal stages.


Musca domestica
Stomoxys calcitrans
Chrysomyia macellaria
Calliphora vomitoria
Lucilia cæsar
Sarcophaga hæmorrhoidalis
Drosophila melanogaster

*Protophormia terræ-novæ* is about .4 in. long; the eyes of the male are closer together than those of the female but not so close as in the male of *Phormia regina;* palpi, light brown or yellowish; prothoracal stigma, black; there are delicate spines along the proximal half of the first section of the third longitudinal vein. See also the next species. It is found about excrement but is not usually common.

*Phormia regina* (Plate LXIX) is fairly common. Its larvæ live in carrion. The palpi are tipped with black; prothoracal stigma red or yellow; and the spines on the third vein are well developed. Both it and the preceding species are likely to be confused with *Lucilia*, but in that genus the front, between the eyes, is usually distinctly margined with white and it is not in these species.

## Methods of Combating Dangerous Muscidæ.

The usual methods employed in fighting the dangerous Muscidæ are really of little avail. Sticky fly-paper, wire fly-traps, and poisons will undoubtedly kill a large number but infinitely more are breeding where these came from. Screening our windows and doors will undoubtedly keep many out but it is not pleasant to live in a cage. Furthermore, the people from whom we buy our milk and other food-stuffs may not be so careful. The only thoroughgoing method is to stop the trouble at its source—prevent breeding. If we could do away with the breeding-places, or make them unfit for fly-larvæ, or keep adult flies away from them, the thing would be done. Nearly all the books and lecturers say that this is easy. It is well to be optimistic but better to recognize the whole truth. It cannot be done *easily*.

"The remedy is simple, effective, practicable, and inexpensive. Destroy their breeding-places and you will have no flies." The latter sentence is manifestly true. Stable manure should be kept in fly-proof bins; treatment with kerosene, chlorid of lime, etc., is not completely satisfactory. Cess-pools must also be made fly proof. Privies must be done away with, or all traces of excrement removed and buried deeply at least once a week.

Garbage must be buried or burned as often. Every bit of organic rubbish must either be kept dry or be destroyed. All these precautions can and should be taken. But—the author quoted above says also: "Of course your neighbor must keep his place clean too, for his flies are just as apt to come into your house [or to get on your food at the dealer's] as his, so the problem becomes one for the whole community." This is the heart of the matter. A few earnest individuals or well-meaning Improvement Societies, acting by themselves, can do little more than cause a great deal of trouble and achieve very little good. Laws must be framed and enforced, so that the ignorant or careless may not make of little or no avail the work of the intelligent and careful. Dr. Howard has well said "*It is the duty of every individual to guard, so far as possible, against the occurrence of flies upon his premises. It is the duty of every community, through its board of health, to spend money in the warfare against this enemy of mankind. This duty is as pronounced as though the community were attacked by bands of ravenous wolves.*"

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We are now about to take up flies which are in the ACALYPTERATE division of some authors. The squamæ are small or vestigal; the first longitudinal vein is short; the eyes of the males never touch each other; and the thorax is without a complete transverse suture. For the most part, these flies are small. The following families are those most likely to be noticed.

### Scatophagidæ

Several species of *Scatophaga* (Plate LXVIII) are common about cow-dung; they are moderately large, yellow-haired flies, with rather slim bodies and longish legs. The adults are predaceous, even catching honey-bees. The larvæ live in excrement.

### Borboridæ

This is a small family of minute, active flies having no distinct auxiliary vein; the first (and sometimes the

second) joint of each hind tarsus is usually short and broad. The adults of *Borborus* and *Sphærocera* are often seen in clouds about the excrement in which the larvæ feed.

The TETANOCERIDÆ (or Sciomyzidæ) are somewhat sluggish, usually brown or yellow flies, many of which have receding chins and marking on the wings. See *Tetanocera* (Plate LXVIII). They are usually found in moist places, the larvæ being aquatic.

*Sapromyza* (Plate LXVIII) is fairly typical of the LAUXANIIDÆ. They are small flies whose larvæ live in decaying vegetation.

### ORTALIDIDÆ

The flies of this and the next family have prettily marked wings. The distinctions between the families are, for the most part, rather difficult to grasp; perhaps the easiest concerns the auxiliary vein. In the Conopidæ, Sepsidæ, Ortalididæ, and other families, it is present and ends distinctly in the costa; in the Trypetidæ, Drosophilidæ, and other families it is absent or incomplete. In the three first-named families, the first longitudinal vein usually ends in the costa, near or beyond the middle of the front margin; in the two last-named ones, it usually ends before the middle. Numerous species of Ortalididæ are usually found in meadows and some (e. g. *Tritoxa flexa*, Plate LXXI) have been bred from onions but the life-histories of most are unknown. The same plate shows *Pyrgota undata*.

### TRYPETIDÆ

The Peacock Flies spend much of their time strutting about with brown- or black-spotted wings elevated and waved back and forth. Some of the females have relatively long, horny ovipositors at the tip of the abdomens. See *Euaresta*, Plate LXXI. Most of the larvæ live in plant tissues.

**Rhagoletis pomonella**

Adults of the Apple Maggot (Plate LXXI) are to be found from July to September. By means of her sharp ovipositor the female punctures the skin of the apple and lays her eggs directly in the pulp. The white larvæ, which taper somewhat toward the front, make winding burrows through the pulp and attain a length of .25 in. or more. They then bore out, usually after the apple has fallen, and go about an inch underground where they spend the winter and spring in a brownish puparium.

The larvæ of similar flies, *Rhagoletis cingulata* and *R. fausta*, are the cherry-worms, known to us all. The currant and gooseberry worm is the larva of *Epochra canadensis*. Several species make galls on goldenrod stems (see p. 457), others mine leaves, live in roots, berries, and fruits of numerous kinds, but practically all have wing-patterns which are distinctive of the species.

### Piophilidæ

Ever see Cheese Skippers? Probably not unless you have lived moderately long or quite near to Nature. The acrobats are larvæ of *Piophila casei* (Plate LXXI). They are about .2 in. long, smooth, and tapered toward the front. The leap is accomplished by holding the tail with the mouth, pulling hard, and then letting go. Why, I do not know. They live also in bacon or other fatty material.

### Drosophilidæ

**Drosophila melanogaster**

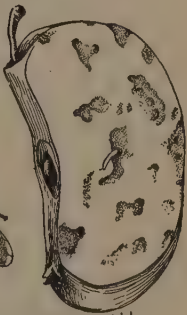
The little red-eyed Pomace-fly (Plate LXX)—also called Sour Fly and Vinegar-fly—is sometimes common about the fruit basket on our sideboard, but it is in the study of heredity and sex that it has become famous, under the name of *D. ampelophila*. Its larvæ feed on ripe, or over-ripe, bananas and other fruit, also on vinegar, stale beer, and the like. The average duration, at living-room temperatures, of the egg period is about 2 days; of the larval period, about 6 days; and of the pupal period, about 5

Pyrgota undata

Tritoxa flexa

Evaresta bella

Rhagoletis pomonella

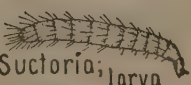


Piophila casei

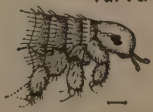
Olfersia americana

Melophagus ovinus

Ctenocephalus canis



Suctoria; larva



Pulex irritans

days. I have kept unmated adults alive, under the same conditions, for about three months. A bit of banana in a milk bottle is all the apparatus one needs to breed this creature and twenty generations a year are easily reared. These facts and its other virtues make it an ideal laboratory animal. Not only have simple cases of Mendelian inheritance been conveniently studied but more complex ones and also the relations between body-characteristics, including sex, and the chromosomes in the germ-cells have been analyzed by its aid. The adults are perfect slaves to light (heliotropic). Put a number of them in a bottle and they will all crowd to the part which is nearest the window, no matter how much you may turn the bottle about. The males are a trifle smaller than the females and have the hind part of the abdomen more largely pigmented. The males have relatively immense "sex combs" on their front legs. These may be for the sake of appearing more attractive to the females, as the males go through their courtship dance, but, on numerous occasions, I cut them off without thereby noticeably decreasing the success of the combless males in the rivalry, which I then staged, with normal males. The "sex combs" may be to clean his antennæ, but how does she keep hers clean? They may just happen to be.

In this brief review of the Acalypterates the following, among other, families have been skipped. HETERONEURIDÆ: the larvæ live in decaying wood, etc., and "skip" like *Piophila*. SEPSIDÆ: *Piophila* has been put here; they often swarm about the decaying vegetables and excrement in which their larvæ live. DIOPSIDÆ: our only species is *Sphyracephala brevicornis*, which occurs on skunk-cabbage and may be recognized by its eyes being on stalks. EPHYDRIDÆ: these small or even minute flies are usually found about moist places; the aquatic larvæ of some species have "rat-tails" like *Eristalis* but the tail is forked; some larvæ live in salt or alkaline water, others in the sap of trees and in leaves. AGROMYZIDÆ: numerous small flies; some larvæ are leaf-miners, others live in plant-galls; others feed on plant-lice, creeping like leeches or Geometrid larvæ.

## PUPIPARA

This group is sometimes given the rank of Suborder. Its members are all ectoparasites, that is, they live on, but not in, their hosts. They are called Pupipara because the larvæ live inside the mother until they are ready to pupate or have already done so. The wings are often vestigal or wanting. They are probably degenerate Acalypterates.

The HIPPOBOSCIDÆ (Plate LXXI) are parasitic upon birds or mammals. The more commonly observed of the winged species belong to *Olfersia* and live on hawks and owls. A wingless species is the sheep-tick, *Melophagus ovinus*.

Members of the family NYCTERIBIIDÆ, also of STREBLIDÆ, usually have no wings, although the halteres are retained. Almost without exception, they are parasitic on bats.

## SUCTORIA

The adult Fleas are small, wingless, laterally compressed, jumping, sucking insects which are parasitic upon warm-blooded animals including man. The larvæ (Plate LXXI) are worm-like; they live in rubbish and dust, such as accumulates at the edges of carpets and in the folds of upholstery. The pupæ are enclosed in cocoons. The family PULICIDÆ contains the common Dog-flea, *Ctenocephalus canis;* the usually rare (with us) Human-flea, *Pulex irritans* (thorax and head shown in Plate LXXI); and a Rat-flea, *Ceratophyllus fasciatus*, which transmits plague in temperate regions. The Jigger-flea or Chigoe, *Dermatophilus penetrans*, of the DERMATOPHILIDÆ, is confused with the Jigger or Chigger, which is a small red Mite and also burrows into human skin. It infests domestic animals and birds, as well as man. The male feeds externally but the female works her way under the skin, causing a serious ulcer through which the eggs are released.

## COLEOPTERA

Beetles may usually be recognized, when adult, by the fact that their front wings ("elytra") are hardened. The elytra usually do not overlap but meet in a line (the "suture") along the middle of the back; in all Staphylinidæ, and in some other groups, they do not, however, completely cover the abdomen. They have chewing mouth-parts. Metamorphosis is complete. The larvæ have no abdominal legs except (often) on the last joint. Twelve or fifteen thousand species are known from North America. The student who desires to specialize is referred to the following two books, from which many of the concise descriptions given here have been copied:

Blatchley, W. S. *An illustrated descriptive catalogue of the Coleoptera or Beetles (exclusive of the Rhynchophora) known to occur in Indiana.*

Blatchley, W. S. and Leng, C. W. *Rhynchophora or Weevils of North-Eastern America.*

Colcoptera are divided by Sharp into the following six series, not counting Strepsiptera (p. 405). For the convenience of American students, I have followed the order of arrangement which is in general use in America. After some familiarity with the various groups has been gained by matching specimens with the pictures, the student will be able to assign most beetles to their proper family on "general appearance."

ADEPHAGA. Tarsi 5-jointed, the fourth quite distinct; antennæ thread-like or nearly so, never lamelliform; abdomen with one more exposed segment at the sides than along the middle, the numbers usually being five and six. See p. 281.

POLYMORPHA. Antennæ frequently with either a club, *i. e.*, the terminal joints broader than the others (the Clavicorns), or the joints from the third onwards more or less saw-like, the serrations being on the inner face (the Serricorns); but these and all other characters, including the number of joints in the feet, very variable. See p. 292.

LAMELLICORNIA. Tarsi 5-jointed; antennæ with the three, or more, terminal joints leaf-like (or at least broader than the others), forming a club, the leaves of which are movable and, in repose, fit together so as to appear to be one piece. See p. 324.

PHYTOPHAGA. Tarsi apparently 4-jointed, the three basal joints usually densely set with cushion-like pubescence beneath; the third joint different from the others in form, being divided into two lobes, or grooved on its upper surface so as to allow the fourth joint to be inserted near its base instead of at its extremity; sometimes the tarsus is distinctly 5-jointed, a very small fourth joint being apparent. Head not forming a definite prolonged beak. See p. 336.

HETEROMERA. Front and middle tarsi 5-jointed, hind tarsi 4-jointed; other characters variable. See p. 380.

RHYNCHOPHORA. Head usually more or less prolonged in front to form a snout or beak; tarsi apparently 4-jointed but with a very minute additional joint at the extreme base of the last joint, usually at least the third joint broad and densely pubescent beneath. See p. 393.

## ADEPHAGA

These are typically carnivorous, both as larvæ and as adults. The larvæ, which are usually very active, have two claws on each tarsus. The Cicindelidæ and Carabidæ are terrestrial and bear numerous fine, erect, bristle-like hairs, especially beneath; the others are aquatic and very smooth.

### CICINDELIDÆ

The adult Tiger-beetles have their eleven-jointed antennæ fastened to the front of the head above the base of the mandibles. These beetles have much recumbent hair, as well as erect bristles; the eyes are prominent; the head is held vertically and is wider than the thorax. "They are long-legged, rather slender, active beetles, predatory in habit, living usually in open sandy places, and flying readily when disturbed. The larvæ are uncouth creatures, with large head and prominent jaws, that live in vertical

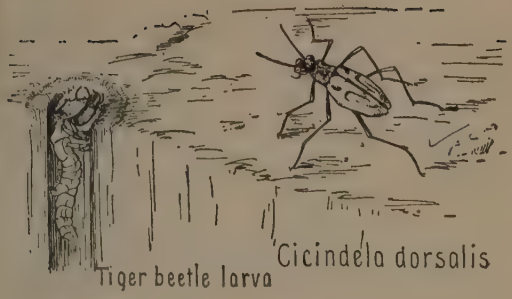
burrows [usually] in sandy soil, watching at the mouth for such unwary creatures as may come their way" (Smith). The larvæ have a hump on the fifth abdominal segment; this hump is provided with forward-pointing hooks that help the larvæ to hold back if their prey should try to get away. See Plate LXXII. The burrow, which is often a foot or more deep and within which the larva pupates, may be recognized by the smooth, circular depression, worn by the larva's feet, surrounding the opening.

**Cicindela**

*Tetracha* of the South and *Omus* of the West live more like Carabidæ but *Cicindela* is the largest genus of the family and the one whose habits have just been described. The following are some of the common species in the Northeast. *C. dorsalis* (Plate LXXII) is white with variable black markings; along the sea-shore in July. Plate LXXIII shows *generosa*, which lives on sandy plains, and *sexguttata* (the number of white dots is variable) of sunny, woodland paths. *C. repanda*, of pond and river banks, is bronzy-brown above with three white marks on each elytron: one (the "humeral lunule") at the shoulder, one (the "apical lunule") at the apex, and one, which is somewhat like an eighth-note in music, in the middle. *C. hirticollis* is like it but hairier and the humeral lunule is upturned at the tip. *C. tranquebarica* is larger (about .6 in. long), the tip of the humeral lunule is down-turned; frequents sandy roads. The last three are most commonly found in spring and fall. *C. punctulata*, which is dark above (greenish-blue beneath) except for white dots, is abundant on roads, garden paths, and even city streets, flying freely to light in midsummer; each elytron has a row of green punctures along the suture in addition to densely placed, uncolored ones. *C. modesta* is black and *C. rugifrons* is green, each with three large white spots; found in pine barrens.

### Carabidæ

Most of the many Ground-beetles are plain black or brown. The antennæ of the adults start from the side of the head between the base of the mandibles and the eyes, which are usually of moderate size; ornamental hairs are


Tiger beetle larva
Cicindela dorsalis

Cychrus elevatus

Carabus vinctus

Harpalus caliginosus

Pasimachus depressus

Dicaelus elongatus

Pterostichus lucublandus

found only in *Brachynus* and *Chlænius* but erect setæ are present and are important in technical classification; the head is held horizontally or slightly inclined and is usually narrower than the thorax. Although some bright-colored Lebiini hunt by day on plants, the majority hide under stones or other cover. If disturbed, they run rapidly but rarely fly except at night, when some species swarm about lights. They are beneficial because of their predaceous habits; the musky odor of many species telling of their diet of flesh. The larvæ are relatively long, and rather flat; they have sharp, projecting mandibles and a pair of posterior bristly appendages; they usually live in underground burrows, pupating in small earthen cells.

*Cychrus* is a genus (late authors divide it into several genera) which is usually rather rare and, since the violet or brownish-purple beetles are of good size, they are often sought by collectors. The pronotum is more or less turned up at the edges. The head and mandibles are long, narrow, and straight, so that they may be thrust into snail-shells in order to draw out the owners; the palpi are shaped like a long-handled spoon. As might be guessed, they are to be found only where snails are common: in moist woods and similar places. See Plate LXXII.

*Carabus* may be separated from *Calosoma* by the fact that the former has the third joint of the antennæ cylindrical and the latter has it compressed.

**Carabus**

The species of *Carabus* are black or brownish-black, and about an inch long. *C. sylvosus:* margins of the turned-up pronotum and of elytra blue; striæ on elytra very fine; usually in sandy woods. *C. serratus:* margins of pronotum (slightly turned up) and of elytra violet; elytra with two or three slight notches in the margin near the base; usually in damp places. *C. limbatus:* bluish margins; pronotum a half wider than long; elytra deeply striate; usually in moist upland woods. *C. vinctus* (Plate LXXII): bronzed, pronotum with a greenish tinge at borders; usually under bark in low, moist woods. All may be caught by sinking bottles or cans, baited with molasses, in the soil.

**Calosoma**

These are usually found, under cover, in gardens, fields, and open woods. They are often abundant at light. Their common name, Caterpillar Hunters, should recommend them, as it is well given. Plate LXXIII gives sufficient help in identifying *calidum* and *scrutator*. *C. externum* is about 1.25 in. long; margins of pronotum and elytra blue; pronotum with the sides rounded, flattened, and turned up behind. Mr. Davis told of a "specimen which was found under an electric light and squirted its acrid fluid into my face at a distance of about a foot." They will do that sometimes. *C. willcoxi* is similar to *scrutator* but only about .75 in. long; the thorax is relatively narrower, and the margins of the elytra are sometimes green. *C. frigidum:* about .8 in. long; black above, greenish-black below; pronotum and elytra with narrow, green margins; spots on elytra, green. *C. sayi:* similar, but found from N. Y. southward while *frigidum* occurs from N. Y. northward. *C. sycophanta* has recently been introduced from Europe to aid in fighting the Brown-tail Moth.

**Elaphrus**

Even after I was supposed to know something about Entomology I tried to place *E. ruscarius* in *Cicindela*. All of the genus have the general form of Tiger-beetles, but they are smaller and lack the ornamental hairs. They inhabit sand-bars and mud-flats. *E. ruscarius* is about .25 in. long; dull brassy above, metallic green beneath; the numerous, circular impressions on the elytra are purplish; legs, reddish-brown. Adults have been taken at Christmas time as far north as Indiana.

**Pasimachus**

A black Carabid, which is an inch or so long and whose pronotum seems too big for it (suggesting a collar that has come loose and moved up the neck), probably belongs to this genus. They occur especially where the soil is sandy, and are caterpillar hunters. *P. depressus* (Plate LXXII) is blue-margined, but often faintly. *P. sublævis* occurs on the beach; the pronotum and elytra are margined (often faintly) with

blue; pronotum squarish but pushed in at the front and somewhat bulged at the sides; tip of closed elytra rounded.

**Scarites** Species of *Scarites* are narrow; the pronotum is rounded behind and somewhat "too big"; the wide, flat front tibiæ are toothed. The common species of our gardens is *subterraneus*. It is usually less than .8 in. long; the southern *substriatus* may be only a large variety of it (an inch or more in length). These species are shiny black; the head has two, deeply indented, parallel lines; the sides of the squarish pronotum are nearly straight and it is separated from the elytra by a neck; the eltrya are distinctly striate. They are often turned up in gardens and feign death by holding the body rigid for a time, but soon run off to shelter.

**Omophron** Circular, yellow beetles, tessellated with dark green, that live by day in the damp sand of brook and pond shores and come out at night to seek their prey. *O. americanum* is our common species.

Numerous, small species of *Dyschirius* and *Clivina* live in damp soil, especially sandy or muddy banks, and may be collected by throwing water on the banks, forcing the beetles out of the ground for air or to satisfy their curiosity as to the state of the weather. They are usually less than .4 in. long and have two bristle-bearing punctures above each eye and at each hind angle of the pronotum. *Pasimachus* and *Scarites* have only one at each of these places. The pronotum of *Dyschirius* is globular or oval and that of *Clivina* is squarish. Other, less common, genera may be distinguished from *Dyschirius* and *Clivina* by the fact that their front tarsi are dilated, while those of *D.* and *C.* are slender, and by the absence of a neck between the thorax and the elytra. *Bembidium* and *Tachys* are remarkable for the speed with which they move and are easily recognized by the short, sharp, needle-like last palpal joint. *Bembidium quadrimaculatum*, less than .15 in. long, with four conspicuous yellow spots, is common in gardens. *Tachys nanus*, all black, and *Tachys flavicauda*, brown with a yellow tip, both less than .12 in. long, are common under the bark of dead trees.

Cicindela sexguttata

Cicindela generosa

Lebia grandis

Calosoma calidum

Calosoma scrutator

Agonoderus pallipes

Platynus cupripennis

Brachinus fumans

ELB

**Pterostichus** The members of this large genus are among the most common of the Carabidæ, but it is difficult to describe, without technicalities, even *lucublandus*, which lives in tilled fields. Plate LXXII shows its general form; its color is greenish or bluish. *Amara* and *Platynus* (Plate LXXIII) are related and also large genera. All the species are small. *Amara angustata*, shining bronze, is common in gardens, running rapidly on paths in midsummer, especially when weeding operations disturb its shelter.

**Dicælus** Similar to the preceding, but differing sufficiently in form to be recognized from the illustration on Plate LXXII is *Dicælus elongatus*, a black, shiny beetle often found under stones.

**Galerita** A slender Carabid, .75 in. long, with blackish head and elytra, and a narrow, reddish-brown pronotum, is fairly certain to be this genus; if the head is strongly rounded behind the eyes, it is probably *janus*. *G. bicolor* is similar but has the back of the head tapering, rather than rounded. They are often abundant about lights but their home is in fence rows or open woodlands. The larvæ are bluish and yellow.

**Lebia** Plate LXXIII shows a species, *grandis*, which is credited with feeding on the eggs and young larvæ of potato beetles. It is fairly typical, although one of the largest, of its genus, the members of which live under stones and leaves but often climb plants to feed on injurious insects. Their tarsi are comb-like, a feature which probably helps them in climbing, and the elytra are square-cut at apex.

The beetles mentioned from *Bembidium* (p. 286) to this point have two bristle-bearing punctures above each eye. The Carabidæ which follow have but one.

**Brachinus** These beetles (Plate LXXIII) have the tip of the elytra square-cut; the head is tapering behind and both it and the thorax are very

narrow, as compared with the abdomen. They occur on the ground under things, usually in damp places. Many Carabidæ, when disturbed, give off a defensive fluid from a gland at the end of the abdomen but species of *Brachinus* do it with a distinct "pop." For this reason, they are called Bombardier Beetles. The discharged fluid is either volatile or it is shot out in a fine spray, so that it looks like smoke.

**Chlænius**

Under stones and logs in damp places are often found Carabidæ with a pronounced musky odor and brilliant, bronzed or green, backs, very finely clothed with short hair. *C. sericeus* is all green, .6 in. long, with yellow legs, while other species of the genus are smaller and variously colored.

**Harpalus**

Plate LXXII shows one of the largest and commonest species, *caliginosus*. It is black with reddish-brown antennæ and tarsi. *H. pennsylvanicus* is also common and is, superficially much like *caliginosus* except that it is rarely more than .7 in. long. For that matter, there are a dozen or more species of *Harpalus*, in almost any region, for which our figure would do except as to size. It might also pass for related genera such as *Selenophorus*, *Stenolophus*, and *Anisodactylus*. Unlike their relatives, some species of *Harpalus* are said to feed, when adult, largely on seeds. *Harpalus viridiæneus*, with shining, greenish-bronze back, is common under boards in farmyards.

*Agonoderus pallipes* (Plate LXXIII) is a small relative of *Harpalus* that often enters houses at night, attracted by the lights.

The next three families are aquatic (see also Hydrophilidæ), although the adults may leave the water to seek mates and new abiding places. The compound eyes of the Gyrinidæ (series Polymorpha) are divided so that they seem to have four such eyes; the abdomen has seven segments; the middle and hind legs form short broad paddles; the antennæ are short. The eyes of Haliplidæ and Dytiscidæ are not divided; the antennæ are thread-like;

and the abdomen has six segments. Haliplid antennæ are 10-jointed and none of the legs are modified for swimming. Dytiscid antennæ are 11-jointed and the hind legs have fringes of long hairs, acting as oars.

### Haliplidæ

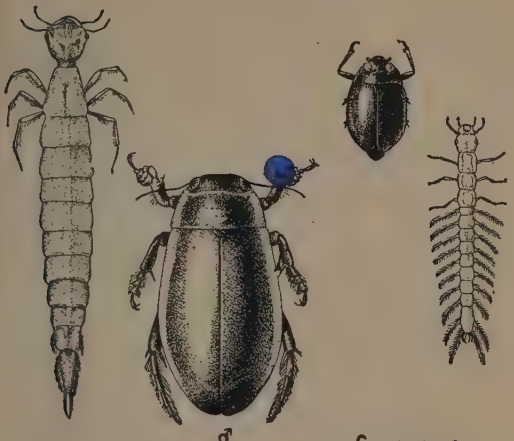
These beetles are small, oval, brown or yellow, more or less spotted with black, and have very much rounded backs. They are widest near the front of the elytra. They crawl about aquatic plants, usually in shallow water, but do not swim well. The larvæ are slender and each of the body-segments has a fleshy lobe on the back, the hind one being long and tapering. Matheson states that they feed on filamentous algæ; if this be so, they are an exception to the carnivorous habits of the Adephaga.

### Dytiscidæ

See above for the characteristics of these Predaceous Diving Beetles. Their larvæ (Plate LXXIV) are called Water-tigers. The adults are said to hibernate in underwater earth but they come out from time to time, especially in early spring. During the summer they are frequently attracted to lights. The males of certain genera, e. g. *Dytiscus*, have the three basal segments of the front (and, to a lesser extent, of the middle) tarsi modified to form cup-like suckers, which may help them to cling to the females while mating. Some females have furrowed elytra. The adults have large spiracles near the hind end and smaller ones along the side. When at rest, they hang head-down with the tips of the elytra sticking out of the water. In this way, the spiracles have access to the upper air. When the beetle dives, a supply of air is carried along under the elytra. Adults discharge, from behind the head and also from anal glands, fluids which differ somewhat from species to species but all of which are probably defensive against fish and other enemies. The mature beetles live for a long time, Harris having kept a *Dytiscus* "three years and a half in perfect health, in a glass vessel filled with water, and supported by morsels of raw meat." Eggs of *Dytiscus*, as far as known, are

laid singly in slits made by the females in underwater plant stems. It is said that *Acilius* lets the eggs drop upon the mud while swimming about and *Colymbetes* arranges its eggs upon leaves. Miall remarks that many a raw naturalist has put these beetles into his collecting-bottle or aquarium, to find after a few hours that they have destroyed or mutilated almost his whole live stock. When the larva swims about in a leisurely way, the legs are the chief means of propulsion, but it can also make a sudden spring by throwing its body into serpentine curves. It may also be seen to creep on submerged leaves, and to cling to them when resting or lying in ambush. The tip of the tail carries two small appendages. These, as well as the last two segments of the abdomen, are fringed with hairs, which no doubt increase the effect of a stroke given to the water. But these appendages are chiefly used to buoy up the tail, when the larva requires to breathe. At length the larva ceases to feed, creeps into moist earth near the edge of the water, makes a roundish cell there, and changes to a pupa.

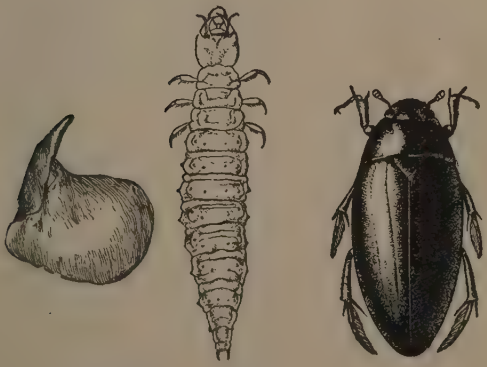
The species of some genera, e. g. *Bidessus*, are less than .12 in. long. The following are among the largest species. *Colymbetes sculptilis:* about .7 in. long; top of head black, with two small, pale spots; pronotum, front of the head, and margins of elytra, dull yellow; a black, transverse, median bar on pronotum; elytra dark. The general color of *Dytiscus* is greenish black. *Dytiscus fasciventris:* length, an inch or slightly more; abdominal segments reddish-brown with darker margins; pronotum margined with yellow only on the sides, or with a faint trace of yellow at base and apex; each elytron of female with ten grooves, which reach beyond the middle. *D. hybridus:* a trifle more than an inch long; abdominal segments uniform black; pronotum like *fasciventris* but shorter; yellow margin of elytra of nearly equal width throughout, a narrow yellow bar near apices; elytra of female smooth. *D. verticalis:* length usually at least 1.4 in.; abdominal segment uniform black; pronotum margined with yellow only on the sides; marginal yellow stripes on elytra narrowing behind; narrow, oblique, yellow cross-bars, near apices, often indistinct; elytra of females smooth. *D. harrisii:*



♂

Dytiscus

Gyrinus



Hydrophilus

length usually at least 1.5 in.; all edges of the pronotum distinctly margined with yellow; elytra marked much like *verticalis* but cross-bar more distinct; females usually have the elytra grooved. *Cybister fimbriolatus* is about 1.3 in long; brown with a faint greenish tinge; pronotum and elytra broadly margined with yellow; front of head, two front pairs of legs, and spots at sides of the third to sixth, inclusive, abdominal segments yellow; pronotum and elytra of female, except along the suture, with numerous, fine, short grooves.

## POLYMORPHA

The following family has also been put in the Adephaga.

### Gyrinidæ

All who observe have seen the steel-blue or black Whirligig Beetles (Plate LXXIV, and p. 288) gyrating in crowds on the surface of relatively still water or basking like turtles on logs and stones. When disturbed, Whirligig Beetles squeak by rubbing the tip of the abdomen against the elytra. They also give off a fluid which is sometimes ill-smelling but in other cases rather pleasantly suggests apples. Although they spend most of their active time on the surface of the water, they can fly well, if they can climb out of the water so as to get a start, and they dive freely, carrying down a bubble of air at the tips of, and under, their elytra. The front legs are long and grasping. Adults are, apparently, not very predaceous, but the larvæ seem to be. The female lays a number of elongate, oval eggs, end to end, upon the leaves of plants, usually beneath the surface of the water and sometimes at a considerable depth. The general appearance of the larva is that of a small Centipede. The pupa of *Gyrinus* is so well hidden that few have ever seen it. Probably about the beginning of August the larva creeps out of the water by climbing up the water-plants, and then spins a grayish cocoon pointed at both ends, the adult emerging towards the end of the same month. Adults hibernate, coming out during mild weather for mid-winter dances.

The two principal genera are *Gyrinus* (length less than .35 in.; the triangular piece, scutellum, between the bases of the closed elytra distinct) and *Dineutes* (length .4 in., or more; scutellum hidden). *Dineutes vittatus:* .5 in. or longer; sides of pronotum and elytra with an indistinct, bronzed, submarginal stripe. *D. discolor:* about .5 in. long; above very dark, almost black, bronze, shining; below, yellowish. *D. emarginatus*: less than .5 in. long; above and below black, slightly bronzed, and not very shiny; middle and hind legs, narrow margin, and tip of the abdomen, paler. *D. assimilis:* length a trifle under .5 in.; above black, strongly bronzed; beneath black, very shining; abdominal segments often tinged with brown; legs brownish yellow; is a common species with an apple odor.

The CLAVICORN series starts here and includes the families to, but not, the Elateridæ. Only Hydrophilidæ are aquatic.

### Hydrophilidæ

These are called Water-Scavenger Beetles. The adults do feed on decaying material but they also eat water-plants and living animals, and, furthermore, not all are aquatic; the larvæ are largely predaceous. The adults have five joints in each tarsus, but the first joint is often very small. The eggs of *Hydrophilus* are usually laid in a floating silken case with a handle-like mast (see Plate LXXIV). The silk comes from glands at the hind end of the female. The larvæ are much like those of *Dytiscus* but clumsier and their tarsi never have more than a single claw, while those of the Dytiscidæ and the Gyrinidæ have two. Pupation occurs in very moist earth at the water's edge; the pupa being kept from touching its cell's bottom by projecting hook-like spines. Unlike *Dytiscus*, the largest spiracles are well forward and air is taken in through the notch between the head and the thorax, the velvety hairs keeping out the water and the hairy club of the antennæ helping to break the surface film. These antennæ, which are less than 11-jointed and broadened at the tip, are sometimes overlooked by the inexperienced,

who mistake the long palpi for antennæ. One of the main groups in the family, the Helophorini (*Helophorus* and *Hydrochus* are the principal genera), is made up of small species which usually have the pronotum narrowed behind, so that it is not as wide as the two elytra. The others have it narrowed in front, the base being as wide as the elytral base. Of these, the Hydrophilini and Hydrobiini have the tarsal joints short. The metasternum of an insect may be described as its breast-bone; it is just in front of the bases of the hind legs. The metasternum of the Hydrophilini is prolonged into a distinct spine and that of the Hydrobiini is not. Finally, the Sphæridiini (late authors make them a separate family) have the first joint of each middle and hind tarsus elongated. Some Sphæridiini, living in manure, decaying sea-weed, and the like, have a wide distribution.

**Sphæridium scarabæoides**

As might be guessed from its generic name, this insect belongs to the Sphæridiini; the specific name was suggested by the fact that it resembles the Scarabæidæ in looks and habits. It is a European insect which was introduced in the latter part of the last century and is rapidly extending its range. It lives in dung. The adult is about a .25 in. long; has a very convex back; shining black above except that the elytra have a reddish spot near the base and the apical fourth is yellowish.

**Hydrophilus**

This genus (Plate LXXIV) contains the two largest species (as well as some smaller ones) of the family. They are both shiny black. *H. ovatus* is about 1.25 in. long; the abdomen, which is unmarked, is pubescent except for a narrow, smooth streak down the middle of the last three segments. *H. triangularis* is larger, even reaching 1.5 in.; the under side of the abdomen is pubescent except for a broad, smooth streak down the middle of all but the first segment; the abdominal segments have more or less distinct, triangular, yellow spots at the sides. They are at times common under electric lights.

*Hydrocharis* is a related genus; *obtusatus* is quite convex

in cross-section, regularly oval in outline, and .6 in. long. It is common in brackish pools.

### Silphidæ

Plate LXXV is sufficient help for the identification of *Silpha* and *Necrophorus*, the only two genera of this family which ordinarily attract notice as Carrion Beetles, although there are not only numerous small species which feed on carrion but some on decaying fungi and a few are found only in ants' nests. There are six ventral abdominal segments; the front coxæ are conical, prominent, and, except in eyeless species found in caves, nearly or quite touch each other.

**Necrophorus**

Species of *Necrophorus* are called Burying Beetles. So many have testified, either from hearsay or from observation, to their burying small carcasses and feeding on them under ground, that it must be true. Probably I have been unfortunate: I have furnished them with numerous carcasses but they ate them all on top of even loose sand. Perhaps the right species did not come to my feast. The sensory pits in the enlarged portion of the antennæ are doubtless olfactory and explain the insects' quickness in locating their particular kind of food. They are all black, usually marked with red or yellow. The following three species of *Necrophorus* have their hind (and, to a lesser extent, their middle) legs bowed. *N. americanus:* an inch or more long; pronotum rounded; orange-red on vertex of the head, central part of pronotum, two irregular spots on each elytron, and club of antennæ. It usually feeds on reptiles. *N. sayi:* less than an inch long; pronotum rounded; orange-red in a cross-bar near base and a spot near apex of each elytron. Not usually common. *N. marginatus:* (Plate LXXV) the elytral spots are sometimes connected along the margin, the basal spot sometimes divided. One of the commonest. The following three have straight legs. *N. orbicollis:* marked much like *sayi*. *N. pustulatus:* pronotum transversely oval, very little narrowed behind; orange-red on antennal club and two spots, the apical one sometimes double, on each elytron. Wholly black

individuals have been recorded. *N. tomentosus:* not over .8 in. long; pronotum broader than long, very little narrowed behind; the disc clothed with yellow hairs; elytral markings resemble those of *marginatus* but are narrower.

**Silpha**

These beetles are extremely flattened. *S. surinamensis:* .6 to 1 in. long; rather elongate; eyes prominent; hind femora of males quite stout; black, usually with a narrower orange-red cross-bar (often broken into spots) near apex of each elytron. The following are oval in shape, the eyes are not prominent, and the hind femora are not enlarged. *S. inæqualis:* about .5 in. long; all black. *S. noveboracensis:* see Plate LXXV. *S. americana:* about .75 in. long; pronotum yellow with a black central spot; elytra brownish with the crinkly elevations slightly darker; pronotum nearly twice as wide as long; much narrowed in front. It occurs on toadstools and in dung, as well as on carrion.

The SCYDMÆNIDÆ are usually less than .12 in. long; shining; oval; convex; brownish or blackish; and usually having erect hairs on the upper surface. They occur beneath bark or stones in moist localities, also in ant's nests. They differ from the Silphidæ in having coarser eye-facets. The hind coxæ do not touch. *Brathinus*, which is found in the North about mossy springs, has been put in this family but its coxæ nearly touch and a separate family, BRATHINIDÆ, is justified.

The PSELAPHIDÆ are also very small. They agree with the Staphylinidæ in having short elytra, but the abdomen is relatively shorter and not flexible. The head and thorax are usually narrower than the combined elytra. Some species "excrete from small tufts of hairs a substance of which ants are very fond, and they are therefore tolerated in numbers in the nests of these insects. They are even said to be fed by the ants and to ride about on the backs of their hosts when so inclined." In general, they are found with Scydmænidæ, and both families are best obtained by sifting.

Silpha noveboracensis

Necrophorus marginatus

Creophilus villosus

Tachinus fimbriatus

Staphylinid larva

Coccinella 9-notata

Megilla fuscilabris

Adalia bipunctata

Hippodamia convergens

Epilachna borealis

Anatis 15-punctata

### Staphylinidæ

The Rove Beetles may be known by their long, narrow form and elytra, which rarely half cover the abdomen. The number of tarsal joints varies from 3 to 5 and is not always the same in the different feet of the same insect; the abdomen has 10 dorsal segments, fewer below. Sharp says that "it is probable that one hundred thousand species or even more of Staphylinidæ are at present in existence." About 2,000 have already been described from the United States and the number is rapidly increasing. Probably fully 200 species can be found in almost any region but their identification is rather technical and no differentiation will be attempted here. "They live on decaying animal or vegetable matter, in excrement, fungi, or fermenting sap, and are among the most universally distributed of all beetles. Many of them are predatory, and some have been accused of feeding on living plants; but on the whole they are of importance to the agriculturist only as scavengers, and as they aid in reducing the dead animal and vegetable matter into shape for assimilation by plants" (Smith). *Creophilus villosus* (Plate LXXV) is common about carrion and excrement. When adults are disturbed, they raise their tails as though they would sting, but all the species are perfectly harmless. *Tachinus fimbriatus* (Plate LXXV) is often found in mushrooms.

We now skip a number of families of very small beetles: Trichopterygidæ, in decaying vegetable matter; Scaphidiidæ, generally shining black, sometimes marked with red or yellow spots, living in rotten wood, fungi, and the like; Phalacridæ, shiny black, very convex, living on flowers or under bark; and Corylophidæ, black or brown, marked with yellow, in fermenting sap, fruits, and other vegetable matter, on dead branches, and under bark.

### Coccinellidæ

I suppose it is a relief to the reader also when we reach, as now, a family whose habits we like. Many of us have quoted

Lady-bird, lady-bird! Fly away home.
Your house is on fire.
Your children do roam.

Some of us add

Except little Nan, who sits in a pan
Weaving gold laces
As fast as she can.

And a few of us know what it is all about. Many Lady-bird (Coccinellid) larvæ live on aphids and this rhyme started in the Old Country, where they burn the hop-vines after the harvest. These vines are usually full of aphids and Coccinellid children. A Nan who can not roam but sits in a pan weaving gold laces is shown on Plate LXXV. She is the yellow pupa. "Why 'Lady-bird' or 'Lady-beetle'?" That goes back still further: to the Middle Ages when these insects were dedicated to the Virgin and were the "Beetles of Our Lady." There are a lot of superstitions about them.

The most distinctive characters of the family are the (apparently) 3-jointed tarsi and the broad, hatchet-shaped terminal joint of the maxillary palpi. They have the antennæ 11-jointed, terminating in a more or less distinct 3-jointed club; head deeply immersed in the thorax, which is transverse, rather small, and strongly emarginate in front; elytra convex, not truncate at tip. Plate LXXV shows a number of common species, some of which are rather variable with respect to color and markings. Smith says that "in a very general way, and subject to many exceptions," those which are red or yellow, with black spots, feed on plant-lice (aphids), and those which are wholly black, or black with red or yellow spots, feed on scale-insects. The larvæ are often prettily marked with black, blue, or orange, and are even more greedy feeders on pests than are the adults. Some species have the curious habit of congregating, as adults, in great masses on mountain tops to spend the winter. Horticulturists of California collect these masses "by the ton," put them in cold storage until wanted, and distribute them among the farmers at the proper season for controlling aphids.

*Epilachna* should be disowned by its family but it can not be. Except for *Epilachna borealis*, all of our species are distinctly beneficial because of their food habits, although the ignorant often accuse them of being the authors of the damage done by the Aphids and Coccids upon which they are feeding. Some Coccinellidæ take a bit of pollen by way of a change, but *borealis*, larva and adult, eats nothing but the leaves of pumpkin, squash, and allied plants. The larva is yellow and armed with six rows of forked, black spines. The adults hibernate. In the West the Mexican *E. varivestis* eats the leaves and green pods of beans.

Here we skip a number of families which are not well represented in the United States. The ENDOMYCHIDÆ are something like Coccinellidæ but the tarsal claws are simple instead of being dilated or toothed at the base. They live in fungi. The EROTYLIDÆ also live in fungi; "elongate or oval in form, and of medium or small size. Many of them are very prettily bicolored, possessing a red thorax, with black or black and red elytra, or the reverse. A number, however, are of one hue." The tarsi are 5-jointed, the fourth joint being small; antennæ distinctly clubbed. The COLYDIIDÆ are slender, rather cylindrical, usually brown, often with ridged wing-covers. They live under bark, in fungi, or in the ground. Some, at least, are predaceous. Up to several years ago only four North American species of RHYSSODIDÆ had been described. They live under bark; and are narrow, elongate, somewhat flattened, brown beetles; head and thorax deeply grooved ("wrinkled"); head constricted to form a pronounced neck; scutellum wanting; first three ventral segments of the abdomen solidly united to each other.

### CUCUJIDÆ

Most of these also live under bark and the last sentence would fit them fairly well except for the last three clauses. The Cucujid head does not taper behind to form a neck; the scutellum is distinct; and the abdomen has five free ventral segments. *Cucujus clavipes* is all-red in color, .5 in. long, and flat as a piece of cardboard. Some Cucujid

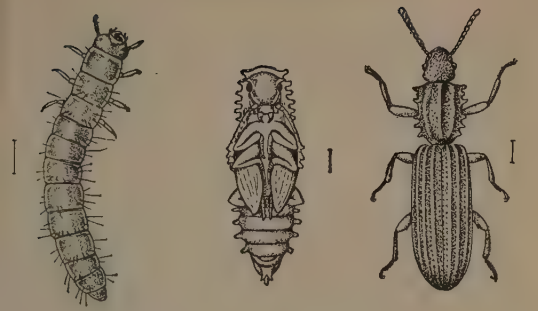
larvæ are predaceous but the following, among others, unfortunately is not.

**Silvanus surinamensis** The enlarged figures on Plate LXXVI are sufficiently descriptive except as to color; the adult is chestnut-brown and the larvæ are dirty white with darker areas. It is one of the most abundant beetles in all kinds of stored grains, especially in the South, and it is sometimes destructive to dried fruits. It is not a weevil, but two of its nicknames are Grain-weevil and Saw-toothed Weevil, the latter referring to its thorax. "The larva, when living in granular material, like meal, usually builds a thin case out of the particles and the whitish pupa may be found within. When the insect is living in substances like fine flour it does not build a case" (Herrick). It is cosmopolitan in its distribution. Several other Cucujids also feed on stored grain, fruits, and nuts, e. g. *Cathartus advena*, which is particularly fond of such as are stale. It is about the same size and color as *surinamensis* but the pronotum is straight-edged and nearly square.

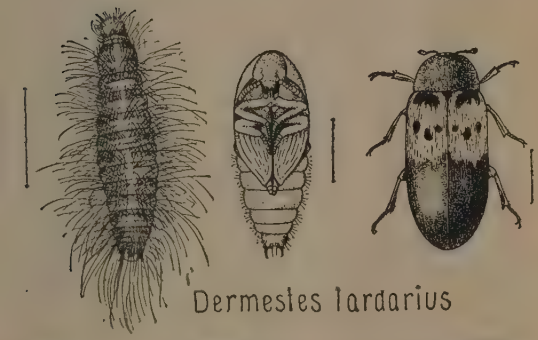
Sharp states that the "Colydiidæ, Cucujidæ, and Rhyssodidæ, exhibit relations not only with other families of Coleoptera Polymorpha, but also with most of the great series; Adephaga, Rhyncophora, Phytophaga, and Heteromera, being each closely approached."

The CRYPTOPHAGIDÆ are usually less than .1 in. long and "often of a light yellowish-brown color, with a silken lustre produced by a very fine pubescence. Their habits are exceedingly variable, some living in fungi, others about wood and chip piles or in cellars, beneath dead leaves, in rotten logs, or on flowers." The last three of the eleven antennal joints are enlarged, loosely forming a club. Some of the males have only 4 joints, instead of 5, in each hind tarsus; the front and middle coxæ are very small and deeply imbedded.

To the MYCETOPHAGIDÆ "belong a limited number of small oval, slightly convex beetles which live on fungi and beneath bark. They have the upper surface hairy and



Silvanus surinamensis



Dermestes lardarius

Attagenus piceus

Anthrenus scrophulariae

densely punctured and the elytra are brown or blackish, usually prettily marked with yellow spots or bands, or yellow with black spots." The tarsi are thread-like and 4-jointed, except that the front ones of the males are 3-jointed, more or less dilated and pubescent beneath.

### Dermestidæ

The name means "skin-devouring" and the species mentioned in detail below are fairly typical of the family. The hind coxæ are dilated into plates, which are grooved for the reception of the femora; the under side of the thorax is hollowed to receive the usually short, clubbed antennæ; tarsi 5-jointed.

**Dermestes**

*D. lardarius* is the common Larder- or Bacon-beetle. The light areas (Plate LXXVI) are pale yellowish. The larva is brown, somewhat hairy, and has two curved spines on the top of the last segment. It feeds on animal substances such as smoked meats, cheese, hoofs, horn, skin, feather, and hair. There may be four or five generations a season. The adult of *D. vulpinus*, the Leather-beetle, is like that of *lardarius* except that the elytra have no light areas, being sparsely and uniformly clothed with a mixture of black and grayish-yellow hairs; the last abdominal segment has two white spots below. Its food habits are much like those of *lardarius* but it prefers skins. Herrick says that certain London merchants offered a prize of £20,000 for a "practical and effectual remedy" but he does not say whether it was awarded or not. There are other species outdoors that seldom do indoor damage.

**Attagenus piceus**

This is the Black Carpet-beetle. In the males the last antennal joint is about as long as all the remainder of the antenna. The larva (Plate LXXVI) is reddish-brown. Like most of the Dermestids the adult does but little damage to our goods; it much prefers pollen as food. The larva goes in for almost anything of animal origin, especially woolens, feathers, and the dried specimens of entomological collections.

**Anthrenus**

These are the Buffalo-moths or -bugs and some are the worst enemies of entomological collections. *A. musæorum* has only 8 joints in each antenna, including the two-jointed club, and the outline of the eyes is not indented. It is found on flowers but is not a frequent visitor in houses. The following species have 11 joints in each antenna, including a three-jointed club, and, except for *verbasci*, the outline of eyes is indented. The pronotum of *A. verbasci* is black, the central part sparsely clothed with yellow scales, the sides more densely with white ones; elytra black, with a large basal ring and two transverse, zigzag bands of white scales bordered by yellow ones; under surface of abdomen clothed with fine, long, grayish-yellow scales. It is the common museum pest. *A. scrophulariæ* is *the* Buffalo Moth. The elytra have brick-red, or dull yellow, markings as shown in Plate LXXVI. I do not know why this genus is connected, by name, with the buffalo, unless the larva has a fancied resemblance to that animal. Possibly it got its nickname by being destructive of buffalo-robes in the days when there were such things. The species frequently injure carpets, but are also found on flowers. They breed in organic matter, presumably in outbuildings or outdoors as well as within, fly to the flowers and may then, in the case of the Carpet-beetle at least, be carried into dwellings before eggs are deposited. Infested carpets should be taken up, thoroughly cleaned, and, if badly infested, sprayed with benzine. Local injury can frequently be stopped by passing a hot iron over a damp cloth laid on the affected part of the carpet.

**Byturus unicolor**

The habits of this creature are not those of other Dermestidæ but, in view of the fact that adults of most of the other species mentioned here regularly leave hides and hair for a sojourn among flowers, it may be retaining the ancestral activities. The adult is about .14 in. long, reddish-yellow or reddish-brown, and covered with a thick coat of pale, tawny hairs. It appears about the middle of May and feeds on the flower-buds and tender foliage of red raspberries. The larva is plump, white, with tawny cross-bands and numer-

ous short white hairs. It feeds in the cup of the berries. Pupation and hibernation occur in an earthen cell just beneath the surface of the ground.

### Histeridæ

It has been suggested that Linnæus, in naming the type genus of this family *Hister*, had in mind a filthy Mr. Hister of Juvenal's Satires. I have not looked up the original but, if the Roman was very bad, the name is not appropriate for all the Histeridæ, as some of them live in a fairly cleanly manner under bark and in ants' nests. Even those which take to carrion and excrement probably do not eat it but feed on the other more Hister-like insects. They are "small, usually black, shining beetles having the elytra truncate behind, leaving two segments of the abdomen uncovered. In form they are variable, either oblong and flat or, more usually, round, oval, globose, or cylindrical. All are very compact, have a very hard surface, and the elytra are usually marked with a number of striæ." The antennæ are elbowed and have a short compact club.

### Nitidulidæ

Some adults are much like the Histeridæ in form but the antennæ are straight; others suggest Staphylinidæ; and, all in all, it is difficult to tell them "at a glance." In most species the pronotum has wide, thin sides. Some feed on fungi or carrion, others are found chiefly in flowers, but the majority feed on the sap of trees and juices of fruits. Dury tells of trapping hundreds of specimens by laying chips on top of a freshly cut maple stump. They are also attracted to a mixture of vinegar and molasses. Some of the species are prettily marked with yellow or red. The genus *Ips* is often common under fallen, decaying fruit as well as about flowing sap. *I. obtusus* is .3 in., or more, in length and *I. quadriguttatus* is less than .3 in. long; both are black with two reddish-yellow (*obtusus*) or yellow (*quadriguttatus*) spots on each elytron. *I. sanguinolentus* is less than .25 in. long; head and thorax

black; abdomen and elytra red, except for tip and two black spots on each elytron. *Carpophilus hemipterus* is an introduced species which is found in grocery and bakery shops. It is about .17 in. long; black, except for the pale legs, a dull yellow shoulder-spot and an irregular area of the same color covering the distal half of each elytron. *Omosita colon* is often seen on greasy bones in the back yard.

The LATHRIDIIDÆ are rarely more than .1 in. long. They are usually reddish-yellow or brownish. Most of the species occur under bark and stones, or in decaying leaves; some are found on plants and some, e. g. *Corticaria ferruginea*, in dried products such as drugs.

TENEBRIOIDES

TEMNOCHILIDÆ

There are not many species and most of them live under bark.

Two species, *mauretanica* (the Cadelle) and *corticalis*, are found in granaries throughout the world. The eighth antennal joint of *mauretanica* is equal to the ninth; in our other species it is smaller. Plate LXXVII is sufficient additional description of the blackish adult Cadelle. The dark areas shown in the illustration of the larva are reddish brown. It feeds on wheat, flour, and other foodstuffs. The fact that it has been found in milk has been used to help prove that milkmen enrich their goods with cornstarch. This larva seems to be rather hardy as Webster recorded its feeding on hellebore. It is said also to feed on other insects and it has been known to bore into the wood of grain bins.

The PARNIDÆ are small (less than .25 in.) beetles which cling with their long tarsal claws to sticks and stones in water, often even in swift streams. The flat, circular larvæ occur in the same places, clinging tightly to their support. Neither stage swims.

It may be of some use to name the families we now skip. It would be of little use to describe them, as the

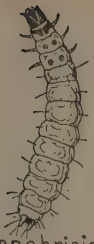
small and not numerous species are rarely noticed. They are the MONOTOMIDÆ, DERODONTIDÆ, BYRRHIDÆ, GEORYSSIDÆ, and HETEROCERIDÆ.

The remainder of the Polymorpha are known as SERRICORNIA. "This series is primarily distinguished, as its name indicates, by the serrate or saw-tooth character of the antennæ. The serrate antenna is, like the filiform, usually slender and of nearly the same width throughout, but differs in having each joint project more or less inwards, this projection being sometimes so long as to form what is called the pectinate, or comb-toothed antenna" (Blatchley). However, Nature is not clear-cut in any of her divisions. Apparently she does not use a card catalog. "System" is a human invention. Passing by the DASCYLLIDÆ and RHIPICERIDÆ we come to a large family some members of which most people have noticed.

### ELATERIDÆ

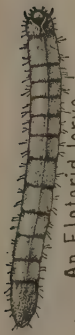
With the exception of the subfamily Eucneminæ, which is considered by some authorities to be a separate family, these beetles have a unique method of getting on their feet if, by chance, they are on their back. They spring into the air and turn over as they go. This trick has won them various names such as Skip Jacks, Click Beetles, Spring Beetles, and Snapping Bugs. Once, in Arizona, I had a guide who had never noticed them before. I made some of the species, which came to the camp light, perform. He immediately christened them Break-backs and began to count up how much he would win, after he got back to Tucson, by betting on "whether they would or wouldn't land right side up." I advised him to put his money on "would" and for nights, thereafter, he hung around my moth-tent, turning Elaterids on their backs to see whether they would or wouldn't. I do not know how he made out.

Break-backs is really not a bad name, as their pronotum is very loosely joined to the rest of the body. Its hind angles are prolonged backward but the elytra slope so that the back can be bowed. This is done when the beetle finds itself wrong side up and then the body is



Tenebrioides mauretanica

Corymbites hieroglyphicus



An Elaterid larva

Elater nigricollis

Melanotus communis

E.L.B.

Showing the "click" apparatus

Alaus oculatus

suddenly a little more than straightened, causing the beetle to bounce into the air. The body is kept from bending too far ventrally by a spine on the hind edge of the prosternum. The antennæ fit, when at rest, in grooves in the prosternum. Most of the species are brown or black and of medium or small size. The larvæ are commonly called Wire-worms. They are long, narrow, cylindrical, hard-shelled, brownish or yellowish-white creatures. Some live in the ground, feeding on the roots of grasses and other plants; some, especially the larvæ of the snapless Eucneminæ, live in dead wood and under bark; and some, at least, are predaceous.

**Alaus**

Two species occur in the Northeast (and elsewhere) but *oculatus* (Plate LXXVII) is the more common. The black-and-white adult flies throughout the season. The larva, which lives in decayed trunks of apple and other trees, reaches a length of nearly 2.5 inches. Lugger concluded that this larva "largely subsists upon other insects" as all that he kept in decaying wood soon died if they were not provided with living insects, "which were soon discovered by these cannibals and devoured." If this be so, it is curious that *myops* is found only in pine, for we would expect that it would be predaceous also and so not particular as to woods. The adult *myops* averages somewhat smaller than *oculatus* and the eye-like spots are not only narrower and smaller but their gray margins are indistinct.

In the South, there are Elaterids which have a pair of very luminous spots on the pronotum. Several years ago some enterprising individual secured a large number of the Cuban *Pyrophorus noctilucus* and sold living specimens at Coney Island. They were probably purchased as curiosities but, in the tropics, ladies wear them as ornaments.

The following United States species occur at least in the Northeast and have relatively conspicuous characters which help in their identification, but which should not be considered conclusive.

*Adelocera discoidea* is from .3 to .5 in. long; black except for the yellow head and margins of the pronotum. Hibernates under bark.

*Elater nigricollis* (Plate LXXVII): head and thorax black; elytra all dull yellowish; occurs under bark and in rotten wood, usually in damp woods. See *Corymbites*. *E. linteus*, similar, but usually smaller, and the elytra are black along the suture and at the apex. Under bark, usually in dry situations. In *E. discoideus* the black covers all the elytra except for the yellow outer margins. Under the bark of hickory, beech, and other trees. *E. rubricollis* is .5 to .7 in. long; pronotum, except the apex and hind angles, red; otherwise black. Under bark and on flowers. *E. collaris* is similar but is about .3 in. long and has no black on pronotum. *E. sanguinipennis* is about .3 in. long; pronotum black, elytra all red. *E. xanthomus* is about the same size but only the bases of the elytra are red; otherwise black.

*Pityobius anguinus* is an inch or so long but narrow; black; antennæ feathered in male. Usually on pine.

*Corymbites pyrrhos* is about .75 in. long; dark reddish-brown; narrow; pronotum relatively long and narrow. *C. tarsalis* is about the size and color of *Elater nigricollis*. They belong to different groups of genera, the Elaterini having the hind coxal plates suddenly dilated about the middle, the outer part much narrower than the inner, and the Corymbitini having them gradually, sometimes scarcely, dilated on the inner side. It is such technical differences which make untechnical catch-characters little more than hints. *C. hieroglyphicus* (Plate LXXVII) is found northward, especially on pine.

*Melanactes piceus* is 1 to 1.4 in. long and polished black. It occurs under stones and rubbish in dry situations.

*Melanotus communis* (Plate LXXVII) is found under the loose bark of fallen trees and is widely distributed. With a strong lens its claws are seen to be comb-like.

The family THROSCIDÆ "contains only a few small, oblong, black or brownish beetles which resemble the Elaterids and the next family, the Buprestids, in form and in having the prosternum prolonged behind into a spine

which fits into a cavity in the mesosternum. They differ from the Elateridæ in having the pro- and meso-sterna firmly joined, and so without the power of leaping possessed by most click beetles. From the Buprestidæ they are distinguished by having the ventral abdominal segments all free" (Blatchley). They are usually found on dead wood or on flowers, and are inconspicuous as well as small.

### Buprestidæ

These are usually elongate, usually stout (but sometimes cylindrical) beetles, with broad thorax, and elytra tapering back from the shoulders; the prothorax closely united to the mesothorax. A large proportion of them are bronzed or metallic in color or reflection, and others are gaudily marked with red or yellow bands or spots. Many of them have the upper surface deeply grooved or pitted, and, altogether, they are very characteristic in appearance. Most of them are very active and fly readily. Square-heads is a local name for them, coined in recognition of their broad, flat, square-cut front.

The larvæ are wood-borers, usually living under bark and making broad, rather shallow furrows, galleries, or chambers. In shape they are very much elongated, somewhat flattened, the body segments well defined, head small, the anterior segments much enlarged so as, apparently, to form part of the head, giving rise to the common names Hammer-head or Flat-head borers. Adults are fond of basking in the sunshine, usually on their own food-plant, and may best be collected by holding an umbrella under branches and then jarring them. Since a taxonomic key involves numerous technicalities, the species to be mentioned will be grouped by their principal food-plants.

#### *Orchard Trees*

**Chrysobothris femorata**

This (Plate LXXVIII) is called the Flat-headed Apple-tree Borer, the name referring to the larva, which, however, attacks numerous other trees such as pear, plum, cherry, peach, oak, sycamore, chestnut, hickory, maple, horse-

Chrysobothris femorata

Dicerca divaricata

Calopteron reticulatum

Photuris pennsylvanica

Photinus scintillans

Phengodes

Chauliognathus pennsylvanicus

chesnut, mountain ash, linden, boxelder, and beech. Adults appear about May, or later, and are given to sitting on tree trunks where they are somewhat difficult to see on account of their dull metallic brown color and roughened elytra. When flying, the bright metallic greenish-blue abdomen is quite conspicuous. The young larvæ make shallow galleries in the sapwood, but as they get older they form somewhat dilated, irregular, flattened burrows in the heartwood, where they hibernate. In the spring they excavate a pupal-cell near the surface, completing the life-history in one year.

**Dicerca divaricata**

The larva of this species bores in peach, cherry, beech, maple, and other deciduous trees. The adult (Plate LXXVIII) is coppery or brassy above; the size and the spreading tips of the elytra, whence the specific name, help to identify it. The males have a little tooth on the under side of each middle femur.

*Small Fruits*

**Agrilus ruficollis**

The Red-necked Cane-borer causes the swellings, usually with numerous slits, which have been called "gouty galls," on raspberry and blackberry. Adults emerge in May and June; they are not over .3 in. long; head short but wide, black; pronotum coppery-red; elytra bronzy-black. "The young larva enters the bark at the axil of a leaf-stem, and eats around the stem in a long spiral. By early August the galls commence to form where the bark has been girdled, though sometimes no gall results from the injury, and the larvæ mine into the pith. The larvæ probably become practically full grown in the fall and remain in their burrows over winter, in which they transform to pupæ in late April" (Sanderson).

*Coniferous Trees*

Buprestids are very fond of conifers and, although this division is quite restricted botanically, relatively few species (all occurring on pine) can be mentioned here.

*Chalcophora virginiensis* is one of our largest Buprestids, attaining a length of 1 or 1.25 inches. Much larger Buprestids occur in the tropics, the family home, and many of them are brilliantly colored. In this genus the hind tarsi have the first joint elongated and the males have a distinct sixth ventral segment. This species is dull black, feebly bronzed, the impressions of the thorax and elytra often brassy; head with a deep, median groove, which is broader and deeper in front; pronotum one-third wider than long, sides rounded on apical third, disk with a broad median impression and two others each side, in the regions of the front and hind angles; elytra each with four to six elongate impressed spaces which are finely and rather densely punctate.

*Buprestis lineata* is .5 in. or more, long. Each elytron has, typically, two longitudinal, yellowish stripes. The general color, above, is metallic black; beneath, dull bronze; head and prosternum, yellowish.

*Buprestis ultramarina* is about .5 in. long; brilliant green with the sutural and outer margins of the elytra coppery red.

*Dicerca punctulata* is superficially much like *D. divaricata* (p. 312) but smaller (about .5 in.), and has a pair of prominent, shining, longitudinal ridges on the middle of the pronotum and parts of a second pair outside of these.

*Melanophila acuminata* (also called *longipes*) is often nearly .5 in. long and all black. It is found on various conifers. *M. fulvoguttata* is about the same size, and has three yellow dots on each elytron; found on spruce and hemlock. *M. œneola* is rarely longer than .25 in.; pronotum bronzy; elytra metallic black.

The males of *Chrysobothris floricola* have a single, acute tooth on each front tibia; those of *dentipes* have none, but the tibiæ are dilated at the tip (those of *femorata*, p. 310, have numerous fine teeth on the inner edge).

### *Deciduous Forest Trees*

The following are among the more easily recognized:

*Buprestis fasciata* about .6 in. long; brilliant metallic green, often with blue iridescence; a wavy yellow band

across each elytron, back of the middle, a yellow spot back of this and sometimes one in front. On maple and poplar.

*Chrysobothris azurea* is usually a little more than .25 in. long. Its color varies from blue to greenish, coppery, and violet. Each elytron has the following brilliant blue or green markings, which appear to be depressed: a somewhat variable streak or combination of spots at the base, one circular spot near the middle, and one two-thirds of the way to the apex. On birch, sumac, and dogwood.

*Brachys*—The several species of this genus are leaf-miners and abundant. The adult larva makes a curious noise, within the mined leaf, by switching his body rapidly.

*Herbaceous Plants*

*Pachyscelus purpureus* mines in the leaves of the bush-clover (*Lespedeza*). The adult is usually less than .2 in. long and the shoulders are so broad that, from above, it looks hunched up. The head and pronotum are black; elytra, purple.

LAMPYRIDÆ

Nearly all Americans who are blessed with eyes have seen Fireflies and many have seen Glowworms. These insects belong to this family but most of the species of Lampyridæ are not luminous. A family characteristic is that the elytra, when present, are thin and flexible; there are seven or eight visible, ventral, abdominal segments. For the most part, the species are predaceous, especially as larvæ. The larvæ usually live under rubbish or the bark of logs and dead trees.

Folsom says: "In Lampyridæ, the light is emitted from the ventral side of the posterior abdominal segments. In our common *Photinus*, the seat of the light is a modified portion of the fat-body—a *photogenic plate*, situated immediately under the integument and supplied with a profusion of fine tracheal branches. The cells of the photogenic plate, it is said, secrete a substance which undergoes rapid combustion in the rich supply of oxygen furnished by the tracheæ.

"The rays emitted by the common fireflies are remarkable in being almost entirely light rays, with almost no thermal or actinic rays. According to Young and Langley, the radiations of an ordinary gas-flame contain less than three per cent. of visible rays, the remainder being heat or chemical rays, of no value for illuminating purposes; while the light-giving efficiency of the electric arc is only ten per cent. and that of sunlight only thirty-five per cent. The light of the firefly, however, may be rated at one hundred per cent.; this light, then, is perfect, and as yet unapproached by artificial means.

"As to the use of this luminosity, there is a general opinion that the light exists for the purpose of sexual attraction—a belief held by the author in regard to *Photinus*, at least. Another view is that the light is a warning signal to nocturnal birds, bats, or other insectivorous animals; this is supported by the fact that lampyrids are refused by birds in general, after experience; young birds readily snap at a firefly for the first time, but at once reject it and thereafter pay no attention to these insects." In some species the eggs, also, are luminous.

The Lampyridæ may be divided into four subfamilies: Lycinæ, Lampyrinæ, Telephorinæ, and Drilinæ.

The Lycinæ have the middle coxæ rather widely separated by the mesonotum. The elytra usually have a coarse network of fine elevated lines. The head is sometimes prolonged in front of the eyes into a long, narrow beak. The antennæ are usually conspicuously saw-toothed or comb-like.

*Lycostomus lateralis:* about .4 in. long; black, with the sides of the pronotum, the shoulders, and the front half of the margin of the elytra, yellow.

*Calopteron:* the elytra gradually widen from base to apex and each has six longitudinal ridges (costæ); antennæ saw-toothed. *C. terminale* is .5 to .7 in. long; black, except for the yellow basal half or two-thirds of the elytra and a very narrow margin of yellow on the sides of the pronotum. *C. reticulatum* and *typicum* are about the same size as *terminale*, but the pronotum, especially of *reticulatum* (Plate LXXVIII), is broadly margined with

yellow, and the yellow area of the elytra is crossed by a black band, which is very wide in *typicum*.

*Celetes basalis* is about .3 in. long; color much as in *Lycostomus lateralis* but the elytral yellow much reduced. The antennæ, especially of the male, are decidedly comb-like (feathered on one side).

*Cœniella dimidiata* is apt to be confused with *Calopteron terminale* but its antennæ are comb-like, not merely saw-toothed.

*Eros*. Most of the species of this genus, and also of *Plateros* and *Calochromus*, are black, with yellow-margined pronota. However, *E. aurora* has scarlet elytra; the under surface of the body is black.

The subfamily Lampyrinæ contains the luminous species. The middle coxæ touch each other; the elytra are not reticulate (netted); and the head is nearly, or quite, covered by the pronotum. The Lampyrini usually have the bases of the antennæ near together. Of the Lampyrini, all except *Photuris* have the head completely covered by the pronotum and the second joint of the antennæ small. *Polyclasis* is the only genus of this tribe having pectinate (comb-like) antennæ, and in it there are pectinations on both sides. In *Lucidota*, *Ellychnia*, and *Pyropyga* the eyes are small and the light-organs are feeble. For the most part, they are black species with yellow on the pronotum. In *Pyractomena* and *Photinus* the eyes are large, but larger in the males than in the females and the light-organs are well developed. *Pyractomena* and *Photinus* are dark brown, or black, with yellow on the pronotum and margins of the wings. These yellow margins are particularly pronounced in *Pyractomena angulata;* the narrow-margined forms are not easily differentiated. The females of *Pyractomena* have the light-organs on the sides of the abdomen and those of *Photinus* have them on the middle. *Pyractomena angulata* is not usually common but is very brilliant. *Pyractomena ecostata* is usually found about marshes, its larvæ probably living on snails. *Photinus marginellus* and *scintillans* (Plate LXXVIII), are very common. The males fly low and have a yellow light. The females have only partially developed wings and do not fly.

*Photuris* (see above) *pennsylvanica* about .5 in. long, or a little longer; head and pronotum dull yellow, the latter with a central red area crossed by a narrow median dark stripe; elytra brownish, with pale markings (Plate LXXVIII). This is the largest and most brilliant of our common fireflies. *Photuris frontalis* is similar but smaller. Both have a greenish light.

The males of *Phengodes*, a genus, which has been placed in both Lampyrinæ and Telephorinæ, are not luminous but the larvæ and wingless females, which usually live under stones, are the most brilliant of our forms, giving off light from lateral joints along the body. They are usually rare. The males may be recognized by their resemblance to the species shown in Plate LXXVIII.

The subfamily Telephorinæ differs from the Lampyrinæ in not having the head at least partly covered by the pronotum. None of the species are luminous and the sexes are much alike. For the most part, they are black or brownish, with more or less yellow on the head and pronotum.

In *Podabrus modestus* the pronotum is all yellow; elytra narrowly margined with yellow; legs black.

In *Telephorus rotundicollis* the head, pronotum, and legs are reddish; elytra, dark gray-brown.

*Chauliognathus pennsylvanicus* (Plate LXXVIII) and *C. marginatus* are called Soldier Beetles. "The species of this genus are known from all others by the elongate head, and by the singular structure of the maxillary lobe, which has a long, extensile, pilose, thread-like process which can be pushed out and used to gather food. In this respect it is somewhat similar to the tongue or proboscis of a moth or butterfly. The mature beetles are said to feed solely upon the honey and pollen of various flowers. The larvæ are, however, strongly carnivorous, those of our common species being very beneficial in that they feed upon the larvæ of the plum curculio and other injurious forms." The two species mentioned above may be separated by the facts that in *pennsylvanicus* the pronotum is wider than long and the head black, while in *marginatus* the pronotum is longer than wide and the

head is yellow with black spots. In both, the light color is yellow. The amount of black on the elytra is very variable, sometimes covering nearly the whole elytra. Adults of *marginatus* appear in the spring and early summer, while those of *pennsylvanicus* are autumn creatures, delighting especially in the goldenrod.

The subfamily Drilinæ has but recently been doubtfully detected in America. *Telegeusis* was described from the Pacific Coast by Horn and is put in this subfamily by some authorities. It was found in 1916 by the author in Arizona. The maxillary lobe is nearly as long as the beetle.

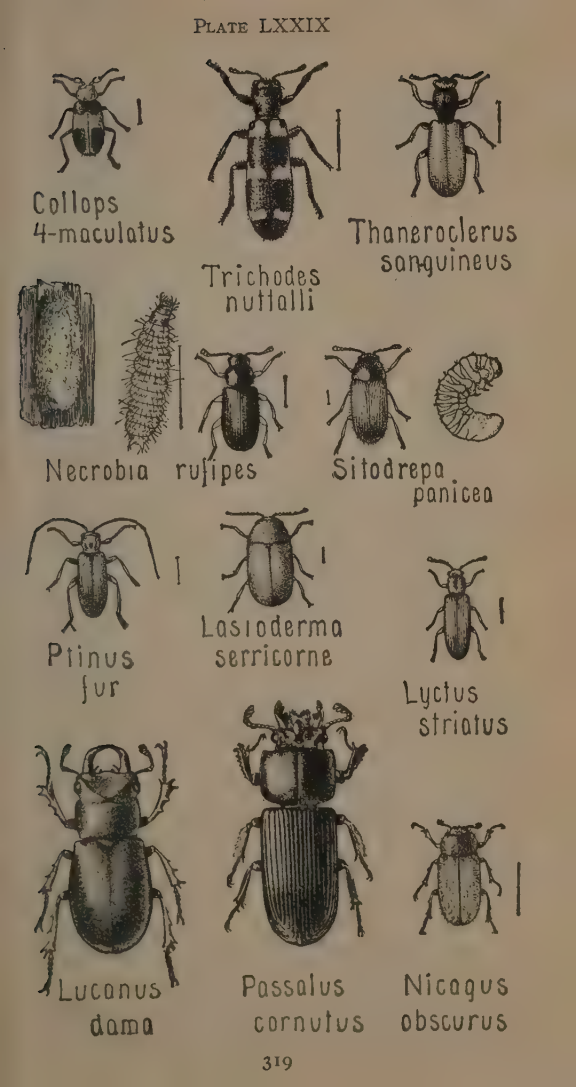
### Malachiidæ

There are not many species in this family. The elytra are soft, as in the Lampyridæ; but Malachiidæ are not luminous, and they have only five or six visible, ventral, abdominal segments. All of them are found on flowers or herbage, some only in moist or low places, where they are said to feed on insect eggs, larvæ, and smaller insects generally. The larvæ, so far as known, are predaceous. *Collops quadrimaculatus* (Plate LXXIX) is one of our largest and commonest species. The head and abdomen are black; pronotum and elytra, reddish-yellow, each of the latter having two blue or bluish-black spots.

### Cleridæ

The Checkered Beetles are rather small, but, for the most part, they are graceful and pretty. The thorax is generally elongate and often much narrower than either the head or the combined elytra. Some look like ants; others resemble Lampyrids. The 11- (or, rarely, 10-) jointed antennæ are enlarged toward the tip somewhat like a club. The tarsi are all 5-jointed but the first and fourth joints are often inconspicuous; all but the fifth have membranous appendages. The usually pubescent adults occur chiefly on flowers, about flowing sap, and on the foliage of trees and low shrubs. Both they and the larvæ are predaceous, especially on wood-boring larvæ.

PLATE LXXIX


Collops 4-maculatus
Trichodes nuttalli
Thaneroclerus sanguineus
Necrobia rufipes
Sitodrepa panicea
Ptinus fur
Lasioderma serricorne
Lyctus striatus
Lucanus dama
Passalus cornutus
Nicagus obscurus

We have three cosmopolitan species of *Necrobia*. They are known as Bone Beetles because they are usually found on carrion after most of the flesh is gone, probably feeding on other insects there rather than on the carrion. *N. rufipes* (Plate LXXIX) is called the Red-legged Ham-beetle from its frequent appearance in that staple. Herrick says: "When the larva gets ready to transform it makes a curious and interesting cocoon in a rather novel way. The larva leaves the fatty portions and gnaws its way either to the harder, more fibrous parts of the ham or may-be into a near-by beam. Here it makes a glistening white cocoon that looks much like paper. The cocoon is not made from silk like the cocoons of most insects, but is composed of small globules of spit out of the mouth of the larva. These globules adhere to each other and when dry form the paper-like cocoon." The three species may be separated as follows (none exceed a quarter of an inch in length):

1. **Pronotum** and base of elytra red; rest of elytra blue or green; head and abdomen black.....*ruficollis*.
   **No** red on dorsal surface, but bluish .....2.
2. **Legs** and basal joints of antennæ red.....*rufipes*.
   **Legs** and antennæ dark.....*violacea*.

*Necrobia* is one of those genera in which the fourth tarsal joint is indistinct and the disk of the thorax is separated from the flanks by a marginal line. In *Trichodes* (front margin of eyes indented; antennal club triangular) and *Thaneroclerus* (eye-margin not indented; the 3-jointed antennal club gradually formed) the fourth tarsal joint is of normal size (the first joint is very small and covered, above, by the second; tarsal claws toothed). *Trichodes nuttalli* (bluish, with reddish-yellow markings) and *Thaneroclerus sanguineus* (brown, with red elytra) are shown in Plate LXXIX.

### Ptinidæ

The small (.25 in. and less in length) beetles of this family are so various that it is difficult to characterize the family. The thorax usually extends above the head like

a hood, the head being bent under and rarely visible from above; the front and middle coxæ are cylindrical or nearly globular; the first of the tarsal joints is often longer than the second. They live on dry animal and vegetable products and in dead wood. The following are rather frequently noticed.

**Sitodrepa panicea**

I had not been at the American Museum of Natural History very long before a mystified lady brought in some red pepper which had been kept in a tight tin box and which, nevertheless, had in it reddish-brown beetles about .1 in. long. A lens showed the characteristic form (Plate LXXIX) and bristling yellow pubescence of this Drug-store Beetle. I assured her that even red pepper is not too strong for it. At least forty-five different drugs, including aconite, belladonna, squill, orris root, and ergot, are in its menu. It has been known to bore through tin-foil and sheet-lead. Printed books are not too dry for it; and it eats all sorts of seeds and dry groceries. There still remained, in the visitor's mind, curiosity concerning the sufficiency of air and water in the "tight tin box." I took her pepper and beetles, put them in a glass vial, corked it, sealed it with paraffin, and put it in an exhibition case, suggesting that she come back occasionally to see how her captives were getting along. At the end of two years and a half there had been numerous generations of offspring which, by that time, had reduced the pepper and part of the cork to such an unnutritious powder that even *Sitodrepa* had to give up. Under favorable conditions there is a generation every two months.

This is a good place to say that there is no such thing as *the* Book Worm among insects. This insect is one. Another of the same family has a record of having "penetrated directly through twenty-seven large quarto volumes in so straight a line that a string could be passed through the opening and the whole series of volumes suspended." This was *Ptinus fur* (Plate LXXIX) the small reddish-brown Spider Beetle whose female has two white patches on each elytron. In fact, almost any insect which feeds on dry, starchy material may eat books.

**Gibbium psylloides**

A spider-like creature, .1 in. long, with globose, mahogany back and pale brown, velvety head and thorax, infests old, not over clean dwellings. It occasionally is found in New York restaurants in the sugar bowl.

**Lasioderma serricorne**

The small burrows in cigars and cigarettes are usually the work of this species (Plate LXXIX), the Cigar and Cigarette Beetle. Although very fond of tobacco, its dietary is much the same as that of *Sitodrepa*. It averages less than .2 in. long, and the last three joints of the antennæ are not enlarged like those of *Sitodrepa;* the front angles of the pronotum are more acute. The white larvæ resemble those of the Drug-store Beetle but are hairier.

**Anobium striatum**

This and several related species bore in the wood of houses and furniture. In the rôle of Death-watch they sometimes play a grim joke on superstitious humans who believe that the ticking sound which the beetle makes portends the death of some one in the house. Swift had the right idea:

> "A kettle of scalding hot water ejected
> Infallibly cures the timber affected;
> The omen is broken, the danger is over,
> The maggot will die, and the sick will recover."

They make the noise by bobbing their heads up and down, tapping the wood. Instead of foretelling death, it is doubtless a call for a mate and new lives.

### Bostrychidæ

These are distinguished from the Ptinidæ by, among other characters, their more cylindrical form and by having the first joint of the tarsi very short and imperfectly separated from the second. The eyes are small, rounded, and somewhat prominent (See Scolytidæ). From Scolytidæ they may be differentiated also by the loose-jointed club of the antennæ. In Scolytidæ this club is a compact knob.

*Sinoxylon basilare* (length about .25 in.; black, with basal third of elytra dull reddish-yellow; apical fourth of elytra

bent downward nearly at right angles on apical fourth, with three tubercles on each side of the declivity) makes short, curved galleries in the branches of a number of trees such as hickory, persimmon, mulberry, apple, peach, and grapevine.

*Bostrichus bicornis* (length, .3 to .5 in.; blackish with irregular patches of yellowish scales; pronotum prolonged in front in two serrate, hooked processes) bores into dead twigs, under bark, and in fungi. Several other similar species occur but this is usually the commonest.

*Amphicerus bicaudatus* is about .3 in. long; dark brown, pubescent; has the pronotum roughened in front with minute, elevated points (two little horns in the male); and males have a thorn-like projection near the end of each elytron. In early spring the adults bore into twigs of apple, pear, and cherry, apparently solely for food and shelter, as the larvæ live in the roots of cat-brier (*Smilax*) and the dead shoots of grapevines.

### Lyctidæ

*Lyctus striatus* (Plate LXXIX), and related species, bore into dry wood of furniture, trimmings, and construction timber, often doing a great deal of harm that is difficult to prevent. They are sometimes called Powder-post Beetles and "all live in dry wood, either in cylindrical burrows or beneath the bark, and sometimes in such numbers that the timber is wholly destroyed by them." Frequently the interior of the wood is largely reduced to powder before the small exit holes of the beetles are noticed. The common species are reddish-brown, cylindrical, and about .2 in. long.

The Serricorn series ends with a number of small families of, for the most part, small, not frequently noticed, species.

### Cupesidæ

*Cupes* is our only genus and the pale brownish or ashy gray *concolor*, .3 in. long, is the commonest species. The eyes are prominent; the head and thorax are narrower than the combined elytra, which are beautifully sculptured

in impressed rows separated by ridges. These insects are found on dead wood and under bark.

### Lymexylonidæ

The name of the typical genus, *Lymexylon*, means "to ruin wood," and the long (about .5 in.), slender, brown with silky pubescence, *L. sericeum*, may occasionally be found, particularly under the bark of oak logs. The very slender larvæ make small, irregular galleries.

### Cioidæ

These are somewhat cylindrical; black or brownish beetles, which rarely are more than .13 in. long. They are usually found under the bark of trees and in dry, woody fungi. Some species have been accused of making small, round holes in woodwork and books, but they are not usually injurious.

### Spindidæ

Similar to the Cioidæ in appearance and habits. Not common.

## LAMELLICORNIA

See p. 281. The front tibiæ are dilated and strongly toothed or scalloped on the outer edge.

### Lucanidæ

These are the Stag-Beetles and Pinching Bugs *par excellence*. The terminal joints, or lamellæ, of the antennæ of this family are not decidedly flattened but are prolonged on the inner side to form a pectinate club, the joints of which can not be brought closely together. Some of the species come freely to lights. The larvæ are fat, white grubs, living in decaying wood.

1. **Elytra** with longitudinal grooves.....4.
   **Elytra** without longitudinal grooves.....2.
2. **Antennæ** elbowed at end of first joint, which is nearly or quite as long as all the others united.....3.
   **Antennæ** straight, first joint not so long; length, less than .5 in.....*Nicagus.*

3. **Length,** .75 in. or more.....*Lucanus.*
**Length,** usually not more than .5 in.; elytra with traces of longitudinal grooves.....*Platycerus.*
4. **Antennæ** elbowed at end of first joint, which is nearly or quite as long as all the others united.....5.
**Antennæ** straight.....6.
5. **Length,** more than .5 in.; eyes strongly notched by the margin of the head.....*Dorcus.*
**Length,** less than .5 in.; eyes not strongly notched. *Platycerus.*
6. **Length,** more than 1 in.; front of head with a short bent horn on head.....*Passalus.*
**Length,** less than 1 in.; no horn on head....*Ceruchus.*

**Lucanus** It is only the males which have abnormally long mandibles. *L. elaphus* is a southern species which gets as far north as New Jersey and Indiana. The mandibles of the male are as long as the abdomen. The female may be separated from the other two species mentioned by her black legs and chestnut-brown elytra. Length of male (not including mandibles), 1.3 to 1.6 inches; of female, about 1.2 inches. *L. dama* (Plate LXXIX), the common species near New York: like *placidus*, the mandibles of the male are only about as long as the thorax; each mandible has but one tooth on the inner side; the head of the male is broader than the thorax; femora, light brown; length, 1 to 1.4 in. The mandibles of the male *placidus*, a species said to be common in the Mississippi Valley but rare along the coast, are straight and have several teeth on the inner side; the head of the male is not broader than the thorax; the femora are dark brown.

*Dorcus parallelus:* brownish black; male's head nearly as broad as the pronotum, female's narrower.

*Platycerus quercus:* blackish or dark reddish-brown; male's mandibles as long as the head, longer than the female's, and with about six teeth at the tip; grooves on elytra usually reduced to three or four faint ones near the suture. Found most frequently under bark of, as its name indicates, oak.

*Ceruchus piceus:* black or dark reddish-brown; male's mandibles as long as the head, with a large median tooth; female's mandibles about half as long as the head, with three or four blunt teeth on inner side; elytral grooves shallow.

*Passalus cornutus* (Plate LXXIX) can make a creaking or a hissing noise by rubbing the elytra. The third pair of larval legs are aborted but in some species, at least, are used to make a noise by scratching the roughened middle legs. Some authors put this genus in a separate family, PASSALIDÆ.

*Nicagus obscurus* (Plate LXXIX) occurs under drift in damp, sandy places.

### SCARABÆIDÆ

This large family (nearly 20,000 species and "increasing by the discovery of about 300 new species every year") contains such forms as the May Beetles (June Bugs), the "shard-borne beetle with his drowsy hum" of Shakespeare, and the Sacred Scarab of Egypt. The larvæ are usually yellowish-white, with a brown, chitinized head bearing prominent mandibles; they are wrinkled, fat (especially at the hind end) "grubs" which live in excrement, in decaying wood, or in the ground, and normally lie on their side with the hind end almost, or quite, touching the legs. Several methods of classifying the members of this family are in use, of which the following is about as convenient as any.

#### Coprinæ

Most of these differ from the rest of Lamellicorns by living in dung and other animal matter. The abdominal spiracles (breathing holes) are placed in a line on the membrane connecting the dorsal and ventral plates and are covered by the elytra when the wings are closed; upper surface of the head usually much dilated on the front and sides. All except the Acanthocerini and Trogini have six visible, ventral, abdominal segments.

Canthon laevis

Geotrupes blackburnii

Copris carolina

Trox suberosus

Pelidnota punctata

Phyllophaga

Macrodactylus subspinosus

*Clæotus* is the only genus of the Acanthocerini (rounded, smooth, shining; scutellum relatively large; five visible, ventral, abdominal segments) that is likely to be found in our region. The species are less than .25 in. long, and live under bark and in rotten wood. Their body is partly contractile so that it can be rolled up into a somewhat hemispherical mass.

Of the Coprini (hind tibiæ usually with a single terminal spur; tip of abdomen not covered by elytra), *Canthon* may be recognized by the slender, somewhat curved, middle and hind tibiæ being but little enlarged at the tip; the males never have horns. The others have these tibiæ much expanded at the tip and the males usually have horns on the head or pronotum. Of these, *Chæridium* and *Onthophagus* rarely exceed .3 in. in length.

**Canthon** These black or bronzed beetles are the Tumble Bugs, which make balls of dung and industriously roll them about (Plate LXXX). *Scarabæus sacer* is a related insect with similar habits; it occurs in the Mediterranean region and was considered sacred by the Egyptians. It seems that this creature, in its form and actions, was believed by them to be emblematical of such abstruse things as the planetary movements and future life, not to mention minor matters. As a matter of fact, we have a great deal to learn about the whys and the hows of the ball-rolling. Comstock wrote that "this is one of the instances, rare among insects, where the male realizes that he has some responsibility as a father, and assists the female in providing for the young." On the other hand, Fabre, observing *S. sacer*, tells of females helping each other to the extent of stealing the ball.

**Copris** Species of this genus do not roll their food to some distant hole for burial but dig a hole in the ground under or near the source of supply, usually cow dung. This hole is then provisioned and a single egg is laid in it. Our three common species are plain black. *C. carolina* (Plate LXXX) is rarely less than .9 in. long and each elytron has but seven longitudinal

striæ. *C. minutus* is less than .5 in. long, while the size of *anaglypticus* is intermediate; they have eight striæ on each elytron.

**Phanæus** These are brilliantly colored beetles. The males of our species have quite a horn on their heads and lack tarsi on their front legs. The first joint of the antennal club is hollowed out to receive the others. The male of *carnifex* is shown in Plate LXXXI. The female has a short, blunt tubercle in place of the male's horn.

No attempt will be made here to give the genera of Aphodiini (hind tibiæ with two spurs; abdomen covered by elytra; antennæ 9-jointed) in detail. *Aphodius* is the largest, both as regards the number of species and by having the largest-sized species. They are dung-feeders which frequently fly in great numbers during warm autumn afternoons and, like their relatives, come freely to light. *Aphodius fossor* is shiny black, nearly .5 in. long. *Aphodius fimetarius* has shiny black head and pronotum and brick-red elytra; it is about .3 in. long. There are many smaller species.

The principal genus, in the Northeast, of the Geotrupini (antennæ 11-jointed; mandibles prominent and visible from above) is *Geotrupes* (Plate LXXX). The antennal clubs are not very large and the plates are of equal thickness. Individuals of our common species range from .5 to .75 in. in length and vary from black to purple and dark metallic green. Some provision holes, as does *Copris*, with dung; others live in decaying "toadstools," especially in the underground stem. Some, possibly all, of the species can make a faint sound by rubbing the hind coxæ against the abdomen. As for the other genera, their antennal clubs are large, round, and convex on both sides. The eyes of *Bolboceras* are partially divided by a process from the side of the head, and those of *Bolbocerosoma* (black-and-brown beetles in which the process between the middle coxæ has an erect tooth-like elevation) and of *Odontæus* (brown beetles without this "tooth") are entirely divided.

As far as we are concerned, *Trox* (Plate LXXX) is the only genus of Trogini. Its species are oblong, convex, dirty-looking, brown beetles, which occur under or about carrion, old hides, or feathers. The surface is usually roughly sculptured and covered with a crust of earth which is difficult to remove. Adults stridulate by rubbing the abdomen against the elytra, special areas being roughened "for this purpose."

## Melolonthinæ

Here belong the June Bugs or Cockchafers. The adults are often very abundant about lights and feed chiefly on leaves. The abdominal spiracles are placed almost in a line but not more than the front three spiracles are on the membrane connecting the dorsal and ventral parts of the abdomen. The larvæ live in the ground and feed chiefly on roots. Our principal genera may be separated as follows:

1. **Middle** and hind tibiæ with only one spur, this sometimes obsolete; hind tarsi with a single claw.....*Hoplia.*

**Middle** and hind tibiæ with two spurs; all tarsi with two equal claws.....2.

2. **Form** elongate, slender; colors metallic green or bronzed or dull yellow.....3.

**Form** robust, heavy; color brownish, sometimes iridescent.....4.

3. **Elytra** pubescent, not densely scaly; claws capable of being folded along the last joint of tarsi...*Dichelonycha.*

**Elytra** densely covered with elongate, yellowish scales; tarsal claws not as above.....*Macrodactylus.*

4. **Five** ventral, abdominal segments; elytra either uniformly and rather finely punctured or with punctured striæ.....*Diplotaxis.*

**Six** ventral, abdominal segments.....5.

5. **Less** than .5 in. long; elytra with indistinct but regular grooves.....*Serica.*

**Usually** more than .5 in. long; most of the elytra without striæ or grooves.....*Phyllophaga.*

*Hoplia*. Adults are usually found on flowers during the day. The two sexes often differ in size and color.

*Dichelonycha*. Adults are usually found on leaves of trees and shrubs. The eyes are rather large and prominent. The antennal club of males is nearly as long as the rest of the antenna.

**Macrodactylus** The name means "long fingered" and all who grow roses will agree that it fits, in both a literal and a figurative sense. There is little you can do to combat this pest unless you wish either to keep your roses, flowers and all, sprayed with poison when the beetles are around or to plow deeply your lawn and the lawns of all your neighbors every winter in order to turn the young of these Rose Beetles out into the cold. It is of some help to go out several times a day and knock the adults which have made their appearance in the intervals into a cup of kerosene. It is said that chickens die from eating them. The Rose Beetle (Plate LXXX) also feeds on grape blossoms. Its specific name is *subspinosus*. A much less common species, *angustatus*, also occurs. It is more southern in its distribution and confines its attentions chiefly to oak and other wild plants. The specific distinctions are slight and technical.

**Phyllophaga** These (Plate LXXX) are the beetles that buzz and bang about the room in the early summer evenings, usually going under the name of *Lachnosterna*. There are numerous species but distinguishing them is a matter of considerable difficulty. The female is said to deposit her eggs, enclosed in a ball of earth, among the roots of grass. The larvæ are "white grubs"; they get to be about as thick as a man's little finger and are frequently very injurious to the roots of various plants. Cases have been reported in which they were so numerous in lawns that they had completely cut the roots; the turf could be rolled up like a carpet. The larval stage of some species, at least, lasts for two or three years. Pupation occurs in an underground cell.

The remainder of the subfamilies have the abdominal spiracles placed in two lines on each side, the front three on the connecting membrane and the others on the ventral segments.

Of the four genera of Rutelinæ (claws on each tarsus unequal in size, the inner one much more slender than the outer) to be mentioned here, *Anomala* and *Strigoderma* have 9-jointed antennæ, and mandibles, when closed, covered by the clypeus; *Pelidnota* and *Cotalpa* have 10-jointed antennæ and the mandibles are usually visible beyond the clypeus. The elytra of *Anomala* are convex, not notched at the base, shallowly striate, and with small holes (punctate); the thorax is not hairy. The elytra of *Strigoderma* are flattened, notched at the base, deeply striate but not punctate; the thorax is hairy and has impressed lines.

*Cotalpa lanigera*, the Goldsmith Beetle (Plate LXXXI), is found on willow and poplar, occasionally on oak, and at light. Its specific name refers to the whitish "wool" on the under side.

*Pelidnota punctata* is, by day, common on grape, drawing the leaves together for shelter, and by night at lights. It is dull reddish-brown or brownish-yellow above, with spots as shown in Plate LXXX. The larvæ live in decaying stumps, especially of oak and hickory.

Of our more common Dynastinæ (claws on each tarsus equal in size; front coxæ transverse, not very prominent; body usually convex above), *Cyclocephala* and *Dyscinetus* have the head and pronotum plain; the others have at least a ridge or a tubercle on one or the other or both. The color of our species of *Cyclocephala* is brownish-yellow; the mandibles are narrow and scarcely curved. Our species are about .5 in. long. The color of *Dyscinetus trachypygus*, our common species, is practically black; the mandibles are broad, rounded on the outer side, and curved. It is nearly .75 in. long and is found under rubbish along the shores of the sea, lakes, and larger streams, as well as at lights. Of the others:

Phanaeus carnifex

Allorhina nitida

Cotalpa lanigera

Desmocerus palliatus

Saperda candida

Cyllene robiniae

Chrysochus auratus

Galerucella luteola

*Dynastes tityus* is over 1.5 in. long. It is usually greenish-gray with brownish or blackish spots scattered irregularly over the elytra. The common name, Unicorn Beetle, is scarcely correct, for the males have three horns on the pronotum, the ones on the sides curved and very short, the median one with yellowish hair beneath, notched at the tip, and projecting forward to meet a long, curved horn arising from the head. The females have only a slight tubercle on the middle of the head. It is a southern insect, rarely seen even in southern New Jersey, for example; I have found larvæ, pupæ, and adults abundant in rotten wood in southern Mississippi.

*Strategus antæus*, the Ox-beetle, is an inch or more long; shiny, dark reddish-brown, the male's pronotum almost black. The male has one stout horn on each side of the pronotum, and one on the front of the same segment; the female has merely the front horn, much reduced.

*Xyloryctes satyrus* is also an inch or more long and rather stouter than the preceding species. Its color is also much like that of the preceding but the male, instead of horns on the thorax, has a long, stout one on the head. It is called the Rhinoceros Beetle, but this is confusing as that name is applied more aptly to certain tropical species.

The Cetoniinæ have the claws on each tarsus equal; coxæ conical, rather prominent; body rather flattened above; the antennæ are 10-jointed. In flying, these insects usually "do not raise the elytra as most beetles do, but the inner wings pass out from the side under the elytra, which are a little narrower at the tips than the base and do not at all embrace the sides of the body. The members of this subfamily differ from the other 'leaf chafers' in being for the most part flower beetles, the mouth organs being furnished with a brush of hairs with which they collect the pollen. They are therefore mostly diurnal, flying about from flower to flower during the heat of the day. At night and in cloudy or rainy weather they are to be found beneath bark or other cover."

**Allorhina nitida**

Plate LXXXI. In the South it is called the Fig-eater. When flying, it is easily mistaken for a loudly buzzing bumble-bee. The head is deeply excavated, the front with a horizontal spine extending forward nearly to the upturned spine of the clypeus. The larvæ feed upon the roots of grass and other plants, sometimes being decidedly injurious.

**Euphoria**

The pronotum is triangular; scutellum not covered; side pieces of the mesothorax visible from above; elytra more or less wavy on the sides. Comstock calls *inda* the Bumble Flower-beetle—a name which covers its habits of humming, when flying, and of feeding in flowers. However, the name might well be applied to its relatives also. The adults often feed on fruit and green corn. The elevation between the middle coxæ is transverse; head and pronotum dark, feebly bronzed, the latter often with yellowish spots; elytra brownish-yellow, mottled with black spots which often tend to form cross-bands; pronotum woolly; length somewhat over half an inch. *E. fulgidus* is similar in size and form but brilliant polished green in color.

**Cremastochilus**

This genus differs from *Euphoria* in having the pronotum quadrate, with prominent angles. The species are uniformly blackish and, while not especially rare, they are not often seen, as they live in and about the nests of ants. Our species are not over .5 in. long. There are pubescent areas near the angles of the pronotum which are glandular and furnish agreeable food for ants. Sometimes even the angles are gnawed off. The beetles are sluggish and "seem to be held in captivity by the ants, which pull them back into the vicinity of the nests whenever they attempt to escape." However, it is probable that the advantages are not entirely one-sided.

**Osmoderma**

The name refers to the "odor of leather." Both of our species are largely nocturnal and come to lights. *O. eremicola* is an inch, or more, long; shiny dark brown; head deeply excavated between the eyes in both sexes, the edge with a tubercle above the base of the antennæ; elytra sparsely punctate. *O. scabra* is not more than an inch long; purplish-black, bronzed; head of male as in *eremicola*, of female nearly flat; elytra roughly sculptured. The larva of the latter, and probably of the former also, lives in the hollows of beech, cherry, and apple trees, feeding upon the rotten wood. In the autumn, it makes an oval cell of fragments of wood strongly cemented with a kind of glue. In this it pupates, emerging the next summer.

**Valgus**

We have only two species of this genus. Their pronotum has a deep median groove, and the body is more or less covered with whitish scales instead of hairs. Adults hibernate in groups on the ground but under some shelter such as half-buried logs. *V. canaliculatus* is .25 in., or less, long; reddish-brown, feebly shining; sides of pronotum, and base, middle, and apex of elytra sparsely clothed with yellowish scales; front tibiæ with three or more slender, widely separated teeth on the outer side. *V. squamiger* is slightly larger and darker; front tibiæ with five or six closely placed, stout, rounded teeth.

**Trichius**

The hind coxæ touch each other; the pronotum is rounded at base and has no median groove; elytra not longer than wide; body pubescent. Three of our more common species may be partially separated as follows, all being a trifle less than .5 in. long. Elytra reddish-brown, tinged with green, without transverse, whitish bands or velvety spots on the sides; head, thorax, body beneath, and legs, bright metallic green: *bibens*. Elytra reddish-brown, each with two short, oblique, whitish bars; head and thorax greenish-black: *piger*. *T. affinis* is much like *piger* but more shining and separated on technical characters.

## PHYTOPHAGA

The tarsi are really 5-jointed but are usually referred to as 4-jointed for the small nodule ("true fourth joint") at the base of the long claw-joint is not usually counted. With this convention and excepting the Spondylidæ, we may say that the tarsi are "apparently four-jointed, the three basal joints usually densely set with cushion-like pubescence beneath; the third joint different in form, being divided into two lobes, or grooved on its upper surface so as to allow of the fourth joint being inserted near its base instead of at its extremity; head not forming a definite prolonged beak; labrum always visible." Almost without exception, the larvæ feed on some part or another of plants. Although the families are sufficiently distinct, once you know them, it is difficult to give a satisfactory elementary key.

### SPONDYLIDÆ

These are called Aberrant Long-horned Beetles and, although apparently related to the Cerambycidæ, they do not fit in the system very well. The fourth tarsal joint is distinct, though not large, so that the tarsi are clearly 5-jointed; the tarsal joints are neither much dilated nor pubescent beneath; the antennæ are short and inserted at the sides of the head near the bases of the mandibles. Only one genus, *Parandra*, and two species need be mentioned here. Both are oblong, reddish to mahogany brown, somewhat flattened, and varying from .4 to .75 in. in length. The antennæ reach about to the back of the pronotum; the second joint about half as long as the third. In *P. brunnea* the pronotum is distinctly wider than the head and punctured; in *P. polita* it is not wider than the head and is not punctured. Both breed in decaying deciduous and coniferous trees, the adults usually being found just under the bark.

## Cerambycidæ

The more than 13,000 species, in addition to the general characteristics of Phytophaga, usually have very long antennæ, extending back of the pronotum and often back of the tip of the abdomen. For this reason, they are often called Longicornes or "Long-horns." Their form is usually oblong, with parallel sides; and they have distinct tibial spurs. When caught, the adults often make a peculiar, squeaking noise. Sharp says they do it "by rubbing a ridge inside the pronotum on a highly specialized, striate surface at the base of the scutellum, and therefore covered up when the Insect is contracted in repose. A few [*e. g.*, some of the Prioninæ] produce noise by rubbing the hind femora against the edge of the elytra, somewhat after the fashion of grasshoppers." The larvæ are white, or yellowish, wood-borers and have powerful jaws; the body tapers slightly from the fore part backwards. They are called Round-headed Borers, in contrast with the larvæ of Buprestidæ. Although many of the adults come to light, the "good species" are usually obtained by the use of good eyes on felled timber or by beating branches, especially dead ones, above an upturned umbrella. Some are also to be found under bark. Large numbers, especially of Lepturini, are attracted in early summer by flowering shrubs. The three[1] subfamilies may be separated as follows:

1. **Pronotum** "margined" (*i. e.*, sides flattened and thin for almost the whole length) and usually toothed along the sides; body usually broad and flattened. Prioninæ (p. 338).

**Pronotum** not margined; body usually more or less cylindrical.....2.

2. **Front** tibiæ not grooved; last joint of maxillary palpi not sharp at tip, often more or less triangular.....
Cerambycinæ (p. 338).

**Front** tibiæ with a more or less distinct oblique groove on the inner side; palpi with the last joint cylindrical, pointed at tip.....Lamiinæ (p. 352).

[1] Craighead, following studies of larvæ, makes five subfamilies.

## Prioninæ

These are among our large beetles, and some tropical species attain a length of six inches or more. The adults are nocturnal.

1. **Form** elongate; antennæ 11-jointed, the joints not overlapping; width of pronotum more than twice its length, three sharp teeth on each side; length, from 1 to 1.7 in.; light chestnut-brown, shining. Larvæ in oak (and other?) stumps and logs.....*Orthosoma brunneum.*

**Form,** stout, broad; antennæ (in our species) 12- to 20-jointed, the joints, especially in males, more or less overlapping each other. *Prionus.* Length from .9 to 2 in.; shining reddish-brown or black.....2.

2. **Antennæ** with 16 to 18 joints in the female and 18 to 20 in the male; pronotum very short and broad, its teeth, especially the hind ones, not very distinct.....*Prionus imbricornis.*

**Antennæ** with only 12 joints.....3.

3. **Elytra,** combined, at base not wider than the pronotum; all joints of the hind tarsi densely pubescent beneath; antennæ of male longer than the body, of female about half the length. (Plate LXXXII.) The larvæ live in the roots of many trees and shrubs, including orchard trees and small fruits such as blackberry; they are three years in reaching maturity.....*Prionus laticollis.*

**Elytra,** combined, at base wider than the pronotum; basal joint of each hind tarsus nearly smooth. Middle and Southern States.....*Prionus pocularis.*

## Cerambycinæ

Quite a few of the very many species are pretty and sure to attract attention.

1. **Base** of antennæ not enveloped by the eyes.....2.

**Base** of antennæ partly enveloped by the eyes; head inserted in the thorax.....8.

2. **Front** coxæ transverse, not prominent; antennæ with second joint rather large, one-third or more the length of the third; head inserted in the thorax. (Division Callidioides).....3.

**Front** coxæ conical (globose in *Distenia*), prominent; second joint of antennæ small; head usually attached to thorax by a rather distinct neck, this appearance being caused by the head being narrowed behind the eyes and the thorax narrowed in front; elytra usually tapering behind the middle. (Division Lepturoides).....4.

3. **Second** joint of antennæ more than one-third as long as the third; antennæ, densely punctured and pubescent; scutellum rounded behind; fifth ventral, abdominal segment of the males transverse and the sixth visible, fifth segment of females prolonged and the sixth invisible. Tribe Asemini (p. 341).

**Second** joint of antennæ not more than one-third as long as the third; eyes finely granulate (*i. e.*, the lines between the facets are feebly impressed) and deeply emarginate; pronotum and elytra not spined; antennæ of males thicker at the base than those of females and usually longer than the body.....Tribe Callidiini (p. 342).

4. **Front** coxæ globose; mandibles chisel-shaped, not fringed on the inner margin; pronotum spined on the sides, and elytra spined at tips; body elongate; head large; eyes large, feeble emarginate; antennæ long, tapering, first joint as long as the head. Tribe Disteniini, of which only *Distenia undata* need be mentioned. It varies from .7 to 1 in. long; dark brown, densely clothed with short, gray pubescence; elytra marked with three serrate cross-bands of darker pubescence. It occurs beneath the bark of hickory, oak, and chestnut trees.

**Front** coxæ conical.....5.

5. **Joints** 3 to 5 of antennæ much thickened at tips; mandibles simple, not fringed; eyes nearly rounded, suddenly and deeply emarginate. Tribe Desmocerini. Plate LXXXI shows *Desmocerus palliatus*. Its larvæ bore in the stems of elder (*Sambucus*).

**Joints** 3 to 5 of antennæ normal, usually slender; mandibles acute, fringed on the inner margin; elytra not colored as above.....6.

6. **Elytra** short, not covering the wings. Tribe Necydalini, of which only *Necydalis mellitus* is likely to be found by users of this book. The abdomen, front and middle

legs, and basal joint of antennæ are dull yellow; elytra reddish-brown or yellow; otherwise black; .5 to .9 in. long.

**Elytra** of normal length.....7.

7. **Front** of face nearly vertical; neck, very short; first joint of hind tarsi much longer than the other joints combined. Tribe Encyclopini. In *Encyclops*, the only genus occurring in eastern United States, the first, hind-tarsal joint is cylindrical. *E. cæruleus* is about .3 in. long; almost linear; shiny blue or green.

**Front** of face oblique or horizontal; elytra usually tapering to the apex..... Tribe Lepturini (p. 349).

8. **Second** joint of antennæ small, not over one-fourth the length of the third; front coxæ not conical though sometimes prominent. (Division Cerambycoides).....9.

**Second** joint of antennæ about one-third the length of the third joint; front coxæ globose, widely separated. Division Atimioides. Rare with us. *Atimia confusa* is about .3 in. long; dull black, clothed with rather long, yellowish pubescence, with irregular, smooth, hairless spots; hind tarsi with the first joint equal to the second and third combined. On conifers.

9. **Eyes** coarsely granulated (*i. e.*, the lines between the facets deeply impressed).....10.

**Eyes** finely granulated.....11.

10. **Front** coxal cavities open behind; abdomen normal in both sexes; antennæ with the second joint small; scutellum rounded behind, except in *Chion;* eyes not divided, though always deeply emarginate.....Tribe Cerambycini (p. 344).

**Front** coxal cavities angulated, closed behind; first segment of abdomen very long. Tribe Obriini. There are two genera: *Phyton*, pronotum much narrower at base than at apex; and *Obrium*, pronotum equally narrowed at base and apex. The species are less than .3 in. long.

11. **Elytra** either only about as long as the pronotum, or elongated and awl-shaped..Tribe Stenoptini (p. 345).

**Elytra** normal.....12.

12. **Scutellum** either rounded behind or broadly triangular.....13.

**Scutellum** acutely triangular; front coxal cavities open behind; eyes finely granulated.....
Tribe Trachyderini (p. 345).

13. **Tibial** spurs large; pronotum never with tubercles or spines.....14.

**Tibial** spurs small; legs long and slender; femora very slender at base, strongly and suddenly club-shaped at apex. Tribe Rhopalophorini. *Rhopalophora longipes* is about .3 in. long; bluish-black; pronotum red, with a small obtuse tubercle on each side.

14. **Tibæ** strongly ridged; form slender; puncturation (pittings) sparse and coarse. Tribe Stenosphenini. *Stenosphenus notatus*, breeding in hickory, is black; pronotum reddish with a central black spot; under side of head and thorax reddish; about .4 in. long.

**Tibiæ** not ridged; form rather stout; puncturation fine. Our species usually have the elytra banded with yellow, or white, and black pubescence; eyes finely granulated and deeply emarginate, the lower lobe always large.....Tribe Clytini (p. 346).

Asemini. (See page 339.)

1. **Color,** black or dark brown; form, cylindrical, scarcely depressed.....2.

**Color,** pale yellowish; form, depressed; length, about .3 in.; eyes coarsely granulated and very deeply emarginate. Occurs under unloosened bark of dead poplar, oak, and other trees.....*Smodicum cucujiforme.*

2. **Eyes** not wholly divided, often deeply emarginate....3.

**Eyes** divided, apparently four in number, rather finely granulated; length, about .5 in.; dull, sooty brown. Northern.....*Tetropium cinnamopterum.*

3. **Eyes** moderate in size, finely granulated and hairy; antennæ finely pubescent; length, .5 in. or more; black. Northern.....*Asemum mœstum.*

**Eyes** large, coarsely granulated, not hairy; about 1 in. long.....*Criocephalus.*

Callidiini. (See page 339.)

1. **Elytra** bluish-black, with narrow, raised, longitudinal, white lines on the middle; pronotum with very deep, median groove; femora distinctly club-shaped; general color, black; .5 to .7 in. long. Larvæ bore in elm..... *Physocnemum brevilineum.*

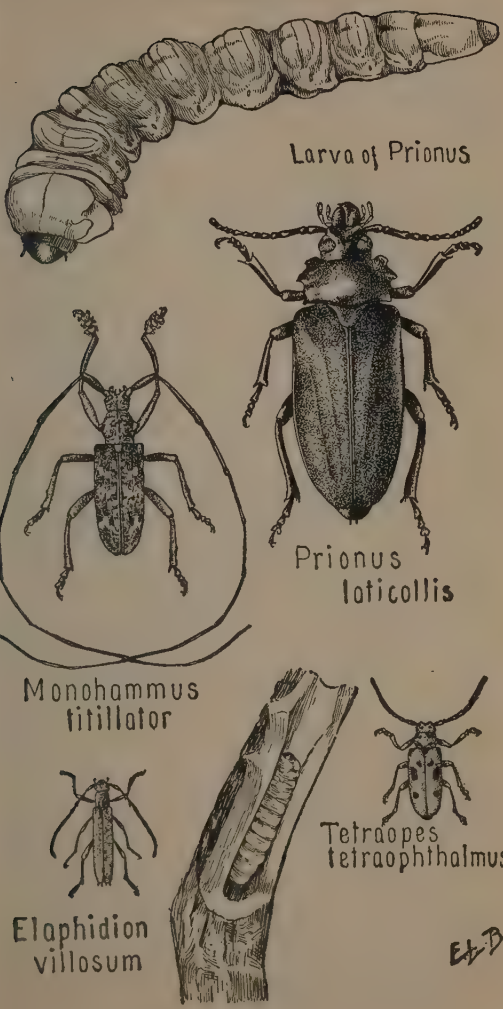
**Elytra** without distinct, raised, white lines..... 2.

2. **Pronotum** very short, strongly rounded on the sides, red; upper surface not shining; black; about .75 in. long. *Rhopalopus sanguinicollis.*

**Pronotum** not very short, the width not much exceeding the length; upper surface more or less shining..... 3.

3. **Front** coxæ at least moderately separated. *Merium* (pronotum with a broad, smooth, shining median space on the basal half) and *Hylotrupes* (pronotum with a narrow median elevation and moderate or small ones on the sides). *H. ligneus* is usually not over .5 in. long; elytra yellow except for apical third and a circular spot on each, which portions are, together with the head and pronotum, bluish-black. Breeds in cedar. *H. bajalus* is about .75 in. long; brown to black, with grayish-white pubescence that may form two irregular bands on the elytra. Breeds in pine and spruce.

**Front** coxæ touching.....*Phymatodes* and *Callidium.* *Phymatodes varius* is black to (especially thorax and basal part of elytra) reddish-brown; two slightly curved crossbars on elytra; about .3 in. long. The larvæ mine the inner bark of diseased oaks. *P. variabilis* (about .5 in. long; elytra blue, or yellow, or blue with yellow margins. Larvæ in oak bark.) and *P. amœnus* (about .25 in. long; elytra bluish. Larvæ in dead grape stems.) have the pronotum reddish-yellow. *P. dimidiatus* has an almost black pronotum; elytra reddish-brown, lighter at the base. The larvæ are "bark-slippers" of cord-wood. *Callidium antennatum* (over .5 in. long; surface rough) and *janthinum* (about .5 in. long; surface shining) are dark blue. They breed in conifers. *C. æreum* is less than .5 in. long and brownish-yellow. Its larvæ mine the inner bark of chestnut.


Larva of Prionus
Prionus
laticollis
Monohammus
titillator
Elaphidion
villosum
Tetraopes
tetraophthalmus
E.D

Cerambycini. (See page 340.)

1. **With** six cross-bands of yellow pubescence, two on pronotum and four on elytra. West of the Alleghanies. Larvæ bore in dead beech and maple. *Dryobius sexfasciatus.*

**With** not more than one yellow cross-band.....2.

2. **Scutellum** acute, triangular, pronotum with a short spine on each side; antennæ of female about the length of the body, of the male longer; brownish, with sparse, fine, gray pubescence; each elytron with two short spines at apex and usually with an oblique, yellow blotch in front of the middle; length varies from .6 to 1.3 in. Larvæ in hickory, oak, and plum.....*Chion cinctus.*

**Scutellum** rounded behind.....3.

3. **Each** elytron with two pairs of elliptical, elevated, ivory-like spots on each; pale brownish-yellow. Larvæ bore in hickory, ash, and honey-locust.....
*Eburia quadrigeminata.*

**Elytra** without pairs of ivory-like spots.....4.

4. **Femora** not distinctly club-shaped; antennal joints and elytra with spines.....5.

**Femora** distinctly club-shaped; elytra without spines at tip. *Tylonotus bimaculatus* (antennæ grooved on the outer side; two rounded, yellow spots on each elytron; .5 in. long. Larvæ in ash.) and *Heterachthes* (antennæ not grooved or hairy; less than .5 in. long). *H. quadrimaculatus* is brownish-yellow with pale spots (sometimes tip also pale) on each elytron. Larvæ in hickory. *H. ebenus* is dull black.

5. **Not** less than .75 in. long.....6.

**Usually** less than .75 in. long.....7.

6. **Dark** brown, with irregular spots of short, grayish pubescence; pronotum without spines on sides. Occurs beneath the bark of walnut, hickory, and hackberry.
*Romaleum atomarium.*

**Reddish-brown** with uniform pubescence of the same color; pronotum with a small tubercle each side of the median line. Larvæ bore in oak and probably other trees.....*Romaleum rufulum.*

7. **Antennæ** and elytra with long spines; femora spinose at tips; dull reddish-brown, irregularly clothed with grayish

yellow pubescence; length, nearly, or quite, .75 in. On various deciduous trees, also on grape.....
*Elaphidion mucronatum.*

**Antennal** spines small; femora not spinose at tips. *Elaphidion unicolor.* Uniform reddish-brown, very sparsely pubescent; pronotum sparsely and irregularly punctate; elytra with a short spine on tip of each. Larvæ bore in twigs of red-bud, plum, and (?) oak. *E. incertum.* Dark reddish-brown, mottled with small patches of grayish-brown pubescence; prothorax almost globose, wider than long, sides rounded; small elevations, sometimes connected, on each side of polished median line of pronotum; each elytron with two short spines at tip. *E. villosum.* (Plate LXXXII.) Dark brown, clothed with grayish-yellow, somewhat mottled pubescence; pronotum rather rough and with coarse, deep punctures; the outer of the two spines on the tip of each elytron the longer. The larva is the Pruner. It breeds in a large variety of deciduous trees, developing in the heart of a small shoot and, when full-grown, girdling the shoot from within, so that it falls in the first high wind. Pupation and hibernation usually occur in this fallen twig, but the twig does not always fall.

Stenoptini. (See page 340.)

*Molorchus bimaculatus.* Dull black, with sparse, long, grayish hairs; elytra scarcely longer than the pronotum, a large, dull, yellow spot often nearly covering each elytron; antennæ and legs reddish-brown; less than .3 in. long. Breeds in dead hickory, maple, ash, dogwood, red-bud, and walnut.

*Callimoxys sanguinicollis.* Dull black; pronotum of male red, with narrow, black, apical, and basal margins; elytra brownish, elongate awl-shaped; femora swollen; hind legs yellow, the tips of the joints black.

Trachyderini. (See page 341.)

This is a large tribe in the South and Southwest, but only four northern species will be mentioned here.

1. **Pronotum** not shining, its sides with a spine or large tubercle; length not less than .5 in.....2.

**Pronotum** shining, its sides unarmed; usually not longer than .3 in.; dark red; antennæ, legs, and often the suture of the elytra varying from dusky red to black. Adults often abundant on flowers.....*Batyle suturalis.*

2. **Body** pubescent; black; each elytron with a large rounded orange spot near the base...*Tragidion coquus.*

**Body** not pubescent.....3.

3. **Black**; each elytron with a large, triangular, scarlet humeral area. Larvæ probably in oak and hickory. *Purpuricenus humeralis.*

**Black**; front half of elytra orange yellow..... *Purpuricenus axillaris.*

Clytini. (See page 341.)

1. **Head** small, face short; process of first ventral abdominal segment between the hind coxæ rounded.....2.

**Head** large, face long; process between the hind coxæ acute.....7.

2. **Pronotum** with three yellow crossbands and excavated transversely at the sides near the base.....3.

**Pronotum** without yellow crossbands, but sometimes with yellow, oblique bars on each side; not excavated at the sides.....5.

3. **Second** joint of hind tarsi without hairs at the middle; antennæ of male longer than the body; velvety black; head, pronotum, and elytra with narrow, yellow crossbands, the third one from the base of the elytra W-shaped, the three behind it sinuous; length .5 to .8 in. Larvæ bore in hickory and elm. Adults in spring and early summer.....*Cyllene caryæ* (also called *pictus*).

**Second** joint of hind tarsi densely pubescent; antennæ not longer than the body.....4.

4. **Closely** resembles *C. caryæ*. Larvæ bore in black locust (*Robinia*). Adults in late summer and fall. (Plate LXXXI).....*Cyllene robiniæ.*

**Basal** third of elytra orange yellow, remainder black except for a yellow band behind the middle, and yellow tip; pronotum yellow, with three short, narrow, black crossbars. A southern and western species.....*Cyllene decorus.*

5. **Antennæ** compressed, somewhat serrate; black, dense

yellow pubescence covering the greater part of the head and forming two short oblique bands on each side of the pronotum and five on each elytron, the first two of which are decidedly oblique and the last (apical) one broad and including a dark spot; length, about 1 in. Larvæ bore in maples and are often injurious. Northern.....
*Plagionotus speciosus.*

**Antennæ** thread-like.....6.

6. **Brownish-black,** densely clothed with velvety pubescence; each elytron usually with a rounded, yellow spot at the base, a small one near it and the margin, a larger one before the middle, and two narrow, transverse, sinuous bands on apical half; antennæ one-half the length of the body, which is .8 in., or more..... *Calloides nobilis.*

**Not** more than .75 in. long; black; head and pronotum covered with grayish pubescence, the latter with a large, black spot in the center and a small, round one on each side; elytra marked with obscure, zigzag bands of grayish pubescence. Breeds in chestnut, oak, and butternut.
*Arhopalus fulminans.*

7. **Elytra** flat on basal third; not less than .3 in. long....8.

**Elytra** swollen on basal third; small, ant-like species, not over .4 in. long.....18.

8. **Front** of head with one or more ridges.....9.

**Front** of head without ridges.....13.

9. **Ridges** on the front of the head reduced to an elongate space; length usually not much more, if any, than .5 in.....10.

**Ridges** on face V- or Y-shaped; length usually not much less, if any, than .5 in.....11.

10. **Ridge** on face divided or impressed longitudinally; black; thorax with four spots of yellowish pubescence; elytra with the sutural line and three oblique extensions from it dull yellow. Usually on black alder.....
*Xylotrechus quadrimaculatus.*

**Ridge** on face scarcely divided; shining black beetle, with yellow margins.....*Xylotrechus nitidus.*

11. **A** spine on the outer angle of the obliquely-cut apex of each elytron; brownish, with white pubescence. Usually on dead pine.....*Xylotrechus sagittatus.*

**No** distinct spine on the outer angle of the obliquely-cut apex.....12.

12. **Black** or brown; yellowish or whitish pubescence arranged to form variable markings; usually four such markings on the pronotum, and three bands (the front one narrow and curved) and an apical spot on the elytra. *Xylotrechus colonus.*

**Black** or dark brown; pronotum with light pubescence on front and back margins; each elytron with a narrow stripe of yellow pubescence running from the scutellum to about the middle and then curving to the outer margin, a short line of yellow in front of this and two behind it. Breeds in spruce and hemlock..... *Xylotrechus undulatus.*

13. **Pronotum** with short, transverse lines or ridges...14.

**Pronotum** without transverse ridges.....17.

14. **Middle** and hind femora spined at apex.....15.

**Middle** and hind femora not spined at apex; black; whitish pubescence on thorax; pronotum with narrow, light, front margin; each elytron with a white or yellow marking which nearly forms a circle near the base, a jagged one just behind the middle, and an oblique one near the apex. Breeds in ash, elm, and hickory..... *Neoclytus capræa.*

15. **Pronotum** with a longitudinal, elevated ridge; antennæ thread-like.....16.

**Pronotum** with a few distinct, transverse ridges arranged in a median row; antennæ thickened towards the apex; reddish-brown; elytra dark behind the first band and with four, nearly straight, narrow crossbars of bright yellow pubescence, the one at the base the least distinct. Breeds in a variety of trees such as elm, maple, black locust, hickory, and dog-wood..... *Neoclytus erythrocephalus.*

16. **Blackish;** two vertical yellow bands on the front of the head and three transverse ones on the pronotum; elytra with the base reddish-brown, the scutellum and three narrow curved bands yellow. Said to breed in hickory, elm, and grape.....*Neoclytus scutellaris.*

**Very** similar but the median yellow band is lacking from the pronotum and there is often a red spot (not of

hairs, but in the chitin) on each side. In hickory.....
*Neoclytus luscus.*

17. **Black** with the following yellow markings: a marginal line on the pronotum, interrupted at the base; scutellum; an oval, oblique spot on basal third of each elytron; a strongly angulated band back of this; and an oblique bar back of the middle. Has been taken on hickory, elm, and oak.....*Clytanthus ruricola.*

**Blackish-brown,** except reddish basal half of elytra. Each elytron with the following markings of whitish pubescence: a narrow, oblique line on basal half; a long, narrow, curved band behind the middle; and a spot on the apex. Has been taken on hickory, grape, and oak.
*Clytanthus albofasciatus.*

18. **Each** elytron with an oblique, wavy band; shining black or dark reddish-brown. Looks like an ant. Breeds in hickory and chestnut branches, possibly in other trees.
*Euderces picipes.*

**No** such band.....19.

19. **Eyes** emarginate; second joint of antennæ distinctly shorter than the fourth, third joint with a spine; black; femora and basal three-fifths of elytra reddish-brown, the latter marked with three narrow, oblique lines of whitish pubescence and separated from the black portion by a similar transverse line. Bores in beech, linden, chestnut, and other trees.....*Cyrtophorus verrucosus.*

**Eyes** not emarginate; head and pronotum black; elytra with markings of silvery hairs. Has been bred from sumac and hickory. Rare....*Tillomorpha geminata.*

## Lepturini. (See page 340.)

Members of this tribe may often be found on flowers.

1. **Spurs** of hind tibiæ not terminal but at the base of a deep excavation; pronotum tuberculate at the sides. *Toxotus. T. vittiger* has two long, longitudinal, whitish stripes on each elytron. *T. cylindricollis* is also black (or reddish) but without whitish markings.

**Spurs** of hind tibiæ terminal.....2.

2. **First** joint of hind tarsi with the usual brush of hair

beneath; pronotum, with rare exceptions, distinctly tuberculate or spined at the sides; head obliquely narrowed behind the eyes.....3.

**First** joint of hind tarsi without the brush-like sole; pronotum usually broadest at the base, its sides never spined or tuberculate; head constricted behind the eyes...8.

3. **Antennæ** scarcely reaching the base of the elytra; pronotum with a sharp spine on each side; elytra with longitudinal raised ridges; black, mottled with brown and gray pubescence; reddish-brown spots on elytra; length, .5 to .75 in. Larvæ under pine bark, making a nest of chips.....*Rhagium lineatum.*

**Antennæ** longer; elytra not strongly ridged.....4.

4. **Eyes** globose and prominent; pronotum with a short, acute tubercle on each side.....5.

**Eyes** not prominent; pronotum angulated or rounded on the sides; length, about .3 in .....6.

5. **Elytra** uniform reddish-brown, somewhat square-cut at tips. Bores in butternut and beech. *Centrodera decolorata.*

**Elytra** clay-yellow with irregular brown stripes and blotches, the tips rounded; length, .5 in. Bores in hickory. *Centrodera picta.*

6. **Head,** pronotum, and under surface black; elytra shining bluish-green; antennæ and legs pale brownish-yellow. Breeds in butternut and probably other trees. *Gaurotes cyanipennis.*

**Not** so. *Acmæops.* For two species see.....7.

7. **Stout;** usually dull brownish-yellow; pronotum with two black spots and each elytron with two longitudinal, black stripes. Western.....*A. bivittata.*

**Slender;** head, pronotum, elytra, and under surface, yellow except for the black suture, a median stripe, and side margin of each elytron.....*A. directa.*

8. **Form** very slender, strongly tapering behind; last ventral, abdominal segment of male deeply excavated....9.

**Form** less slender and less tapering behind; last ventral segment not excavated.....12.

9. **Longer** than .75 in.; elytra strongly sinuate on the sides; chestnut-brown to black, the elytra with paler areas. Breeds in ash.....*Bellamira scalaris.*

**Smaller**.....10.

10. **Head** and pronotum wholly black; elytra dull yellow, with margin and suture blackish....*Strangalia acuminata.*

**Head** and pronotum not wholly black.....11.

11. **Elytra** yellowish, usually marked with black. *Strangalia famelica* (antennæ black) and *S. luteicornis* (antennæ yellow).

**Elytra** wholly black; head and pronotum reddish-yellow.....*Strangalia bicolor.*

12. **Antennæ** with smooth, impressed, pore-bearing spaces near the bases of the sixth or seventh and the following joints. *Typocerus. T. iugubris* is all-black. The elytra of *velutinus* are reddish-brown with four yellowish spots (which may be enlarged to form partial bands) on each, and of *zebratus* are black with one or two basal spots and three bands, all yellowish, on each elytron.

**Antennæ** without such spaces. The large genus *Leptura*, of which the following are fairly common.....13.

13. **Pronotum** rather triangular or bell-shaped, widest at base.....14.

**Pronotum** more squarish or rounded, usually constricted in front and behind, hind angles not prolonged; length, .3 to .5 in.....16.

14. **Hind** angles of pronotum prolonged.....15.

**Hind** angles not prolonged; length, .4 to .6 in. *L. rubrica* (antennæ ringed with yellow; elytra reddish; pronotum black; abdomen of male red, of female black) and *proxima* (antennæ not ringed; elytra dull yellow except at tips, which are broadly and obliquely marked with black).

15. **Over** an inch long; pronotum black, with yellow pubescence; elytra red, with black tips...*L. emarginata.*

**About** .5 in., or less, long. *L. lineola* (narrow; elytra decidedly narrowed behind, yellow, with black sutural, median, and marginal stripes, which may be broken) and *nitens* (pronotum black, with yellow pubescence, much rounded in front of middle; elytra black with four golden crossbars).

16. **Pronotum** scarcely narrowed in front and not constricted behind; black; the elytra sometimes dull yellow or with the tip alone dark.....*L. mutabilis.*

**Pronotum** much narrowed in front but only feebly so at base; elytra protuberant at base. *L. vittata* (head prolonged behind the eyes; shining black but each elytron with a yellow stripe, rarely wholly black) and *pubera* (head not prolonged; entirely black).

## LAMIINÆ

Adults of this subfamily (see p. 337) are, as a rule, not as brightly colored as those of the preceding one, nor are they as active by day as some of their relatives. The larvæ differ from the remainder of the Cerambycidæ in that they have no legs. Those with elytra about half the length of the abdomen, and front tibia not grooved, belong to the tribe Methini, which some authors place in the Cerambycinæ.

1. **Elytra** about as long as the abdomen and with a spine or protuberance near the scutellum; rarely more than .25 in. long.....2.

**Elytra** about as long as the abdomen but without such a spine or protuberance; usually at least .25 in. long. 3.

2. **Frontal** coxal cavities rounded. Tribe Cyrtinini. *Cyrtinus pygmæus* is dark brown; antennæ ringed with yellow; elytra with a transverse blotch of white pubescence before the middle. It lives on oak, hickory, locust, and box elder.

**Frontal** cavities angulated. Tribe Psenocerini. *Psenocerus supernotatus* is reddish-brown or blackish; scutellum, a narrow oblique band about the middle of the elytra, and a wider curved band, not reaching the suture, on apical third, white. Larvæ in stems of currant, gooseberry, grape, and sometimes in apple twigs.

3. **First** joint of the antennæ with a scar-like structure near the tip (except in *Dorcaschema*); body elongate, nearly cylindrical; antennæ as long as, in males much longer than, the body; mostly large species.....Tribe Monohammini. (p. 353.)

**First** joint of the antennæ without the scar-like structure.....4.

4. **Tarsal** claws (at least those on the front legs) arising at opposite sides of the joint and separating widely.....5.

**Tarsal** claws spreading only slightly from a common base.....8.

5. **Front** coxal cavities rounded; middle coxal cavities closed or nearly so; body usually broad; antennæ usually very long in males.....Tribe Acanthoderini (p. 355).

**Front** coxal cavities angulate; middle cavities open...6.

6. **Tarsal** claws simple (except the outer one of the front and middle tarsi in some males of *Saperda*).....7.

**Tarsal** claws cleft or with appendages.....
Tribe Phytœciini (p. 361).

7. **Small,** flattened species; pronotum with a spine or tubercle on the sides.....Tribe Pogonocherini (p. 358).

**Rather** large, cylindrical species; pronotum without spines or tubercles.....Tribe Saperdini (p. 359).

8. **Front** of face large and flat; front coxæ angulated. Tribe Onciderini. *Oncideres cingulata* is about .6 in. long; antennæ of male longer than the body, of female about as long; general color, smoky or reddish-brown to clay-yellow, almost always lighter in a broad band across the elytra; usually three small black dots in a cross-row on the pronotum. The female lays her eggs in twigs of hickory (especially), apple, pear, plum, elm, linden, and other trees; then chews a girdle around the twig below the eggs. The twig dies and, broken off by the wind, falls to the ground where the larvæ mature. Adults are somewhat abundant in August and September.

**Front** of face bent in; form very slender and elongate. Tribe Hippopsini. *Hippopsis lemniscata* is about .5 in. long; dark reddish-brown; pronotum with two whitish lines on each side; each elytron with three whitish lines; antennæ pale brown, darker at bases, more than twice as long as the body, fringed with hairs beneath. Breeds in stems of ragweed (*Ambrosia*) and in other herbaceous plants.

Monohammini. (See page 352.)

1. **Legs,** especially the front ones of males, relatively long.....2.

**Legs** not especially long and all about equal; pronotum with a spine on each side.....8.

2. **Pronotum** with spines on the sides.....3.
**Pronotum** without spines.....5.

3. **The** sutural angle of elytra acute or projecting as a short spine; brownish, the elytra mottled with gray; antennæ of male sometimes four and a half times the length of the body; Plate LXXXII. The variety *carolinensis* is paler and not much over half as long. Breeds in pine.....*Monohammus titillator.*
**The** sutural angle not prolonged.....4.

4. **Black,** distinctly bronzed, the elytra with very small or no patches of white and brown pubescence; length .6 to 1.1 in. Breeds in pine.....*Monohammus scutellatus.*
**Brown;** elytra sparsely mottled with small patches of gray and brown pubescence; length about 1.2 in. Larvæ in the inner bark and sapwood of dead and dying pines, spruces, and balsams.....
*Monohammus notatus* (also called *confusor*).

5. **Elytra** rounded at the tip; black or grayish-brown....6.
**Elytra** pointed at the tip; black, densely clothed with uniform ash-gray pubescence; length, .3 to .5 in. Breeds in walnut, mulberry, osage-orange, and hickory.
*Hetæmis cinerea.*

6. **Thorax** cylindrical, longer than wide; brown with grayish pubescence.....7.
**Prothorax** slightly narrowed behind the middle, nearly as wide as long; uniform dull black; length, .3 to .4 in. Breeds in hickory.....*Dorcaschema nigrum.*

7. **Pronotum** transversely wrinkled, indistinctly punctured; length, .6 to .9 in. Breeds in mulberry and osage-orange.....*Dorcaschema wildii.*
**Pronotum** not wrinkled, distinctly punctured; length, .3 to .5 in. Breeds in mulberry and osage-orange.....
*Dorcaschema alternatum.*

8. **Surface** brownish; antennæ of male not more than a fourth longer than the body.....9.
**Shining** black, pubescence whitish; elytra coarsely punctured and each with a small, black spot behind the middle; antennæ of male about twice the length of the body, which is about .4 in. Breeds in oak and hickory.....
*Goes oculata.*

9. **Elytra** with a conspicuous space on the apical half which is not pubescent.....10.

**Elytra** without a conspicuous bare space on the apical half; nearly an inch long.....12.

10. **Length** about an inch.....11.

**Length** about .5 in.; brown; head, pronotum, and last third of elytra with reddish-yellow pubescence, basal part of elytra mottled with grayish pubescence. Breeds in oak, probably also in chestnut and hickory...*Goes debilis.*

11. **Pubescence** white. Breeds in hickory, oak, and possibly other trees.....*Goes tigrina.*

**Pubescence** dark brown, silvery, and reddish-yellow; there is a broad, transverse, lighter band across the elytra and the tips of these have golden pubescence. Breeds in hickory.....*Goes pulchra.*

12. **General** pubescence brownish; elytra with small spots of yellowish hairs arranged in irregular rows. Breeds oak.....*Goes tesselata.*

**General** pubescence grayish or whitish; elytra indistinctly crossbarred at base, and again behind the middle, with pale-brown pubescence; scutellum sometimes clay-yellow. Apparently breeds in elm, ironwood, beech, and oak.....*Goes pulverulenta.*

Acanthoderini. (See page 353.)

1. **Basal** joint of antennæ club-shaped; pronotum with dorsal tubercles and a large, acute spine near the middle of each side; about .5 in. long.....2.

**Basal** joint of antennæ cylindrical; spines on sides of pronotum, if present, behind the middle.....3.

2. **Dark** brown, with yellowish-brown pubescence; each elytron with a large, wavy, white crossbar near the middle and a row of small alternate brown and white spots along the suture. Larvæ live in oak, hickory, beech, and hackberry.....*Acanthoderes quadrigibbus.*

**Dark** brown, with yellowish and gray pubescence in about equal proportions, the gray on elytra in three obscure, oblique, nearly parallel bands; an indistinct, M-shaped, black mark behind the middle of each elytron. On poplar and hickory.....*Acanthoderes decipiens.*

3. **Females** with an elongated ovipositor. This is a very unsatisfactory sort of a character to have in a key, but I know of no better. *Acanthocinus* has no erect hairs in the pubescence above; the antennæ are very long, with at least joints 3 and 4 densely fringed beneath with short hairs. *A. obsoletus* is dull yellowish with small blotches and three undulated crossbars on elytra; length, .4 to .6 in. *Ceratographis* (mesosternum narrow) and *Graphisurus* (mesosternum broad) have erect hairs. *G. fasciatus* occurs under the bark of deciduous trees. It is grayish, sprinkled with black spots and usually having two larger blotches back of the middle of each elytron; .3 to .6 in. long.

**Females** without elongated ovipositor; except as noted, usually not over .3 in. long.....4.

4. **Pronotum** distinctly angulate, or more frequently with acute tubercles or short spines behind the middle...10.

**Pronotum** only feebly tuberculate or angulate at the sides a little behind the middle.....5.

5. **Elytra** with small, tubercular elevations, each bearing on its summit short, black, scale-like hairs.....6.

**Elytra** without such structures; .2 to .4 in. long.....9.

6. **Pronotum** densely punctured; elytra with densely placed, coarse, deep punctures; brownish, irregularly mottled with grayish pubescence; each elytron with an elongate, dark spot behind the base, another (sometimes becoming a bar) behind the middle, and a third near the apex. Breeds in pine.....*Leptostylus sexguttatus.*

**Pronotum** not densely punctured; elytral punctures not closely placed, often inconspicuous or concealed.....7.

7. **Surface** of pronotum not tuberculate, regularly punctured.....8.

**Surface** of pronotum more or less tuberculate, the punctures irregularly placed; blackish-brown with grayish pubescence; elytra with a whitish band behind the middle, this band narrowing toward the sides and edged with a black line behind which the surface is smoky brown; joints of basal half of antennæ spotted, those of apical half ringed at tips with brown. Larvæ under the bark of diseased or recently cut sycamore, oak, apple, and other trees.....*Leptostylus aculiferus.*

**8. Dull** brownish-yellow; sides of pronotum and of base of elytra black; elytra very indistinctly punctured, especially at the apex, and having an angulate, white band behind the middle. Breeds in hickory.....
*Leptostylus biustus.*

**Brownish,** with very fine, dark gray pubescence; elytra distinctly punctured over the entire surface, the tips slightly prolonged, an acutely angulate, oblique, white band behind the middle. Breeds in oak and box elder.
*Leptostylus parvus.*

**9. Brownish;** pronotum with whitish pubescence forming a broad stripe on each side, banded within by a narrow, blackish stripe formed by a row of elongate, bare tubercles; each elytron with a broad, irregular, white blotch behind the middle and with six lines of minute, black spots. Breeds in butternut, walnut, hickory, beech, and other twigs.
*Leptostylus macula.*

**Dull** clay-yellow; elytra sprinkled with minute, black spots and irregular patches of dark and gray. Breeds in chestnut.....*Leptostylus collaris.*

**10. Antennæ** without fringed hairs beneath; first joint of hind tarsi as long as the next two.....**11.**

**Antennæ** distinctly fringed beneath with hairs; first joint of hind tarsi as long as the next three.....**13.**

**11. Form** cylindrical; elytra with erect hairs, which may be seen when viewed from the side; prostrate ash-gray hairs cover the black color; an acute spine on each side of pronotum near the base; .3 to .4 in. long. Breeds in ragweed (*Ambrosia*), the larvæ hibernating in the stems.....*Dectes spinosus.*

**Form** somewhat flattened; elytra without erect hairs.....**12.**

**12. Purplish-brown,** mottled with black; elytra with numerous, small, irregular, black spots and a dark blotch, bordered behind by gray, back of the middle; .3 to .5 in. long. Breeds under the bark of honey-locust and box-elder.....*Liopus variegatus.*

**Usually** dull reddish-brown with sparse, grayish pubescence; elytra usually with four rows of small, black dots and with an acute-angular, black band behind the middle; pronotum with three, small, blackish spots.

Breeds in sumac, apple, hickory, and locust. *Liopus alpha.*

**Much** like *alpha* but the oblique band on each elytron (making the acute angle when the elytra are closed) is replaced by an obscure band of gray. Breeds in dogwood (*Cornus*) and plum..... *Liopus punctatus.*

**13. Each** elytron with a distinct ridge on the outer side. *Hyperplatys*, of which *aspersus* is our common species. It is reddish-brown, with grayish pubescence; pronotum with four black dots in a transverse row; each elytron with three irregular rows of similar dots and usually a large, black blotch behind the middle.

**Elytra** without a ridge on the outer side. *Lepturges*, of which we have several rather variable species. The spines on the sides of the pronotum of *symmetricus* are rather broad and very close to the base. In the others they are more slender and acute, not so close to the base and the tips are recurved. The crossbar on the elytra of *signatus* is interrupted at the suture; in *querci* (apex of elytra not black; crossbar angular) and in *facetus* (apex black; bar transverse) it is broad and complete.

Pogonocherini. (See page 353.)

These beetles usually have long, erect hairs, in addition to the ordinary pubescence. The antennæ are about the length of the body, the joints progressively shorter toward the tip. The following species are .25 to .5 in. long.

**1. Femora** club-shaped; vertex of head concave; antenna tubercles prominent.....4.

**Femora** not club-shaped; vertex flat or convex; antennal tubercles not prominent; eyes coarsely granulated, lower lobe as wide as long. *Eupogonius*.....2.

**2. Spine** on side of thorax acute, well-marked.....3.

**Spine** on side of thorax obtuse, small; black, with a broad line of yellowish pubescence on each side of pronotum. On elm and linden..... *E. subarmatus.*

**3. The** puncturation of elytra feeble, almost obsolete near apex; pubescence ash-gray or yellowish, forming more or less transverse nettings. Has been bred from apple twigs but is said to occur also on pine. *E. tomentosus.*

**The** puncturation coarse, gradually finer, but distinct,

at tip; pale yellow pubescence arranged in irregular, small patches. Breeds in dog-wood, hickory, walnut, pine, and perhaps other trees.....*E. vestitus.*

4. **Lower** lobe of eyes elongate; spines on sides of pronotum large, median; pubescence mottled, gray and black, mixed with short, scattered hairs on elytra. Breeds in dry twigs of beech and linden.....*Hoplosia nubila.*

**Lower** lobe of eyes as wide as long, squarish or somewhat triangular.....5.

5. **Pronotum** with spines on sides; black, elytra variegated with dull brownish-yellow, and with a broad, oblique band of white pubescence. Beneath bark of dead pine, also on pear and willow.....*Pogonocherus mixtus.*

**Pronotum** with feebly rounded sides; pale grayish-brown; elytra with a narrow, curved, black band on basal third. Breeds in red-bud, hickory, and probably other trees.....*Ecyrus dasycerus.*

Saperdini. (See page 353.)

*Saperda* is our only genus. *S. candida* is shown in Plate LXXXI. The larva is known as the Round-headed Apple-borer (see p. 310) but it also lives in quince, *Cratægus*, and *Amelanchier*. The larvæ usually work in the base of the trunk and in the large roots, more rarely in the large limbs. Their presence may often be detected by piles of "saw-dust" pushed out of the burrow through an opening in the bark. From egg to adult takes three years. Pupation occurs in the burrow. The adult, in emerging, makes a hole in the bark as big around as a lead pencil. Adults emerge throughout the season, starting as early as April.

Two more of our species have complete, longitudinal stripes on the elytra: *puncticollis* (two pairs of black dots on top of the yellow pronotum and one dot on each side) and *lateralis* (pronotum dark, with yellowish side-stripes). The latter breeds in hickory and some specimens (variety *connecta*) lack the narrow, yellow sutural line but have developed oblique crossbars. Virginia creeper is the food-plant of *puncticollis*.

*S. concolor* is about .5 in. long and evenly clothed with

fine, gray pubescence. Its larvæ make galls in poplar and willow stems. The male *discoidea* also has unmarked elytra; they are dark; there are light grayish lines on the pronotum and the underside is silvery; legs reddish. The female is yellow on the head, pronotum, scutellum, a crescentic bar in the middle of each elytron, and a spot in front and behind each of these. It breeds in hickory and butternut.

*S. vestita*, the Linden-borer, is olive-yellow but each elytron has three small, black dots. Large specimens are an inch long.

Our largest species is *calcarata*, the Poplar- and Cottonwood-borer. It is usually at least an inch long; dense, gray pubescence, with the front of the head, three stripes on the pronotum, the scutellum, and numerous lines and blotches on the elytra, orange-yellow.

*S. obliqua* (reddish, with lighter, oblique markings on the elytra, which are spined at the tip; .6 to .8 in. long) and *mutica* (black, with light markings; elytra not spined; .4 to .6 in. long) have distinct color-rings on their antennæ. The former breeds in alder; the latter, more western, in willow.

*S. cretata* is a fairly common apple-borer, especially in the Middle West. It is brown, with two large, white spots on each elytron and white stripes on the sides of the pronotum; length, .5 to .8 in. *S. fayi* is rarely .5 in. long; darker and more slender than *cretata;* the elytral spots narrow, and near the suture, and an additional small spot at the base. Both make gall-like swellings in stems of *Cratægus*.

*S. tridentata*, the Elm-borer, is grayish-black; there is an orange stripe on each side of the pronotum; each elytron has a narrow orange stripe near the margin and three bands, of which the last two are quite oblique and usually meet the corresponding ones on the opposite side; the front of head is very flat; .4 to .6 in. long. *S. imitans* resembles it but the elytra are rounded at their apices, instead of being somewhat truncate; the elytral markings are narrower, yellower, and the hind band is not distinctly oblique.

Phytœciini. (See page 353.)

1. **Each** eye not divided but the outline deeply indented; thorax cylindrical.....2.

**Each** eye completely divided so that there appear to be four eyes; thorax dilated or tuberculate on the sides...9.

2. **Antennæ** without hairy pile.....3.

**Antennæ** with thick, long hairs; black, feebly shining; top of head, a stripe on each side of the pronotum, and often the margins of the elytra, yellowish; .3 in. long..... *Amphionycha flammata.*

3. **Nearly** uniform gray above; tarsal claws feebly toothed or cleft. Breed in stems of herbs..... *Mecas*, usually *inornata.*

**Not** uniform gray above; tarsal claws broadly toothed; .3 to .7 in. long. *Oberea*.....4.

4. **Pronotum** with small, rounded, black elevations or callosities.....5.

**Pronotum** without callosities.....8.

5. **Pronotum** with four callosities; usually pale, dull yellow; elytra, antennæ, and tarsi often nearly black. Breeds in living twigs of cotton-wood.....*O. schaumii.*

**Pronotum** with two callosities, and often a third spot, black. There are several named color-varieties of each of the following species.....6.

6. **Tips** of elytra rounded; body, below, and femora entirely red; head and thorax usually red, rarely more or less black; two rounded, black spots on middle of pronotum; elytra black. Probably breeds in blackberry stems. *O. ocellata.*

**Tips** of elytra rather square-cut.....7.

7. **Shining** black except the pronotum, which is yellow with two, or three, black spots. Breeds in the canes of raspberry and blackberry.....*O. bimaculata.*

**Typically,** the body, beneath, is largely yellow but it is sometimes wholly black; pronotum yellow with three black spots; each elytron with a wide, dull yellow stripe bordered with blackish. Breeds in cottonwood and blackberry.....*O. tripunctata.*

8. **Thorax** pale reddish-yellow; antennæ, elytra, tibiæ, and tarsi, nearly black; pronotum without black spots;

elytra rather densely clothed with gray pubescence. On sumac and sassafras.....*O. ruficollis.*

**Pale,** dull yellow with a dark brown elytral stripe on each side.....*O. gracilis.*

**9. Elytra** black; head and pronotum red, the latter with a black spot. On alder. *Tetrops monostigma* (elytra with black hairs; western) and *T. canescens* (elytra with grayish hairs; eastern).

**Elytra** red with black spots; head and pronotum red. *Tetraopes*, of which the following are the more common species. *T. canteriator:* pronotum with four round, black spots; black areas on elytra form, when elytra are closed, a heart-shaped space back of the middle; apex of elytra also black; .3 to .5 in. long. *T. tetraophthalmus:* pronotum with four black spots near the middle and sometimes a blotch in front and behind; see Plate LXXXII. *T. femoratus:* a western species, resembles *tetraophthalmus*, but the apex and base of each joint of antennæ are narrowly ringed with gray; .5 in., or more, long. They are usually found late in summer on milkweed, in the stems and roots of which they breed. They stridulate loudly. The extent of the black markings varies somewhat.

### Chrysomelidæ

The Chrysomelidæ of the United States are never more than moderately long, as beetles go; their antennæ are not very long, and their bodies are often chunky. Nearly a thousand species are known from North America, about a twentieth of the number known from the rest of the world. One way of looking at the food habits of beetles is that adopted by the celebrated Coleopterists, LeConte and Horn: "As the function of the Cerambycidæ is to hold the vegetable world in check by destroying woody fiber, the Bruchidæ effect a similar result by attacking the seeds and the Chrysomelidæ by destroying the leaves." The potato-grower would have to be a philosopher in order to look at the Chrysomelid *Leptinotarsa* in that way. Not all Chrysomelidæ are leaf-eaters, however, as will be pointed out in the course of the discussion. No attempt will be made to enable the reader to identify a large proportion

of the species he may find, as was done with the Cerambycidæ. This is partly because of technical difficulties, including the large number of species, and partly because many of the species are small and not usually noticed. All of them are diurnal.

The following hints may be useful. If the head is constricted or neck-like behind the eyes, and the prothorax is narrower than the combined elytra, the specimen belongs to one of the following tribes: Donaciini, Sagrini, or Criocerini. If the pronotum and elytra have broad, expanded margins, the head concealed from above, and the outline of the body ellipitical or nearly circular, see Cassidini (p. 376). If the beetle is wedge-shaped, broad, and square-cut behind, especially if the elytra are pitted or have a net-work surface, see Hispini (p. 375). If the hind femora are thickened, fitting the beetle for jumping, and the antennæ are rather close together at the base, see Halticini (p. 372). As for the rest, the majority of those usually noticed are either Chrysomelini (antennæ usually further separated at the bases than the length of the first joint; front coxæ transverse and widely separated; third tarsal joint rarely indented; see p. 368) or Galerucini (antennæ rather close together at base, inserted on the front; front coxæ conical and prominent; see p. 370).

## Donaciini

In addition to the characters given above, this tribe may be recognized by the fact that the first ventral, abdominal segment is about as long as all the others combined. They look very much like certain Cerambycidæ. Their larvæ live on the outside of the submerged roots of water-lilies, skunk-cabbage, pickerel-weed, sedges, and other aquatic or semi-aquatic plants. They pupate in cocoons, a number of which are often fastened in a row to the stems or roots of their food plants. The adults of *Donacia* are commonly seen on the leaves of water lilies and other aquatic plants in early summer, and fly from leaf to leaf when disturbed. The color is usually more or less metallic greenish, bronze, or purple; they are coated beneath with a satiny pile of fine hair. *Donacia* has numerous species

all of which have the tips of the elytra simple, and the tarsi dilated, spongy beneath. With the exception of this genus, the Northeast has only *Hæmonia nigricornis*, which has narrow tarsi and a distinct spine at the outer angle of each elytron. Adults of *Donacia* rarely enter the water, except to lay eggs, but those of *Hæmonia* are more aquatic.

### Sagrini

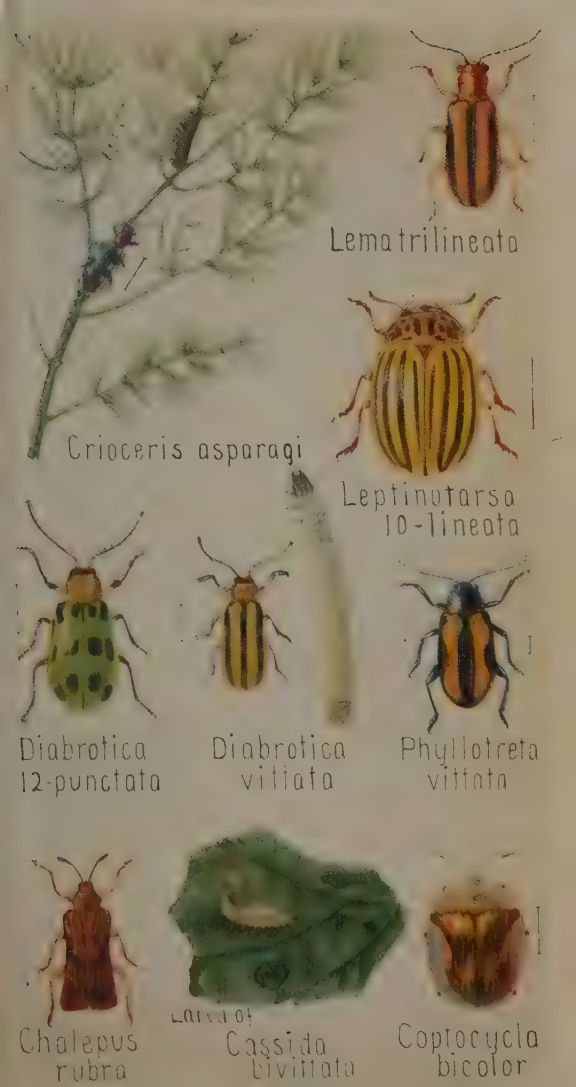
In addition to the characters given above, members of this tribe may be recognized by their first ventral, abdominal segment being not much longer, if any, than the two following; tarsal claws cleft or toothed and elytral punctures irregular (not in rows). Our only common species is *Orsodacna atra*. The sides of its pronotum are rounded and have neither tooth nor tubercle—in distinction from *Zeugophora* (outline of eyes indented) and *Syneta* (outline of eyes not indented). Its color is so variable that seven or more named varieties are recognized. It may be practically all black, or the pronotum and elytra may be reddish or yellowish, variously spotted or striped with black. It is about .25 in. long and is often abundant on willow and other very early blossoms.

### Criocerini

Members of this tribe may be distinguished from the Sagrini by their simple claws and their elytral punctures being in rows. There are two genera: *Lema*, in which the pronotum is constricted at about the middle, and *Crioceris*, in which it is not.

**Lema**

The most frequently noticed species is *trilineata*. It is sometimes called the Old-fashioned Potato-beetle because it was at work eating potato leaves before *the* Potato-beetle came north and east. It usually lays its eggs along the midrib of a leaf, not in a cluster but at random. Its larvæ have a curious, but not unique, habit of piling their excrement on their backs. Pupation takes place underground. The adult is shown


Lema trilineata
Crioceris asparagi
Leptinotarsa 10-lineata
Diabrotica 12-punctata
Diabrotica vittata
Phyllotreta vittata
Chalepus rubra
Larva of Cassida bivittata
Coptocycla bicolor

n Plate LXXXIII. In *brunnicollis* the elytra are wholly dark blue; head and pronotum red. In *collaris* the elytra are wholly dark greenish-blue; head, black; pronotum, red.

**Crioceris**

We have two species; both are from Europe and largely confined, as yet, to the East; and both attack asparagus. *C. asparagi* (Plate LXXXIII) was introduced about 1862 near New York. The three yellow spots are sometimes joined. Adults hibernate under rubbish. The dark-brown eggs are usually laid in rows. Pupation occurs underground; there are several generations a year. *Crioceris 12-punctata* is a trifle larger; red with six black spots on each elytron. It was introduced about 1881 near Baltimore. Adults emerging from hibernation eat the young shoots but the larvæ prefer the ripening berries to "leaves." This species pupates underground.

## Clythrini

Adults of this tribe, also of the Chlamydini and Cryptocephalini, have "the basal ventral plates of the abdominal segments somewhat shorter in the middle than at the sides, the fourth one being often invisible in the middle, while the fifth is very large." Sharp further says: "This character appears to be connected with a very remarkable habit, viz., the formation of a case to envelop the egg. The tip of the abdomen is somewhat curved downwards, and, in the female, bears a hollow near the extremity; when an egg is extruded the female envelops it with a covering said to be excrementitious. When the larva hatches, it remains within this case, and subsequently enlarges it by additions from its own body." The Clythrini have short, serrate antennæ, which are not received in marginal grooves on the lower side of the thorax; the prosternum does not extend between the front coxæ; the pronotum has thin side-margins and fits closely against the elytra. The larvæ of *Coscinoptera dominicana* are said to feed on vegetable debris in ants' nests.

### Chlamydini

See the discussion under Clythrini, from which tribe these beetles differ by having the upper surface of the elytra and pronotum covered with wart-like tubercles and by having their short, serrate ("saw-toothed") antennæ received in grooves on the under side of the thorax. "The legs are closely contractile and when disturbed the beetles draw them and the antennæ in and feign death. They then resemble the excrement of certain caterpillars so closely as to render their detection difficult, unless the collector is in especial search for them, and it is said that birds will not pick them up for the same reason." The larvæ are case-making leaf-feeders and pupate in their cases, which they first attach to twigs. We have two genera: *Chlamys*, whose antennæ are serrate from the fourth or fifth joint; and *Exema*, whose antennal serrations begin at the sixth joint.

### Cryptocephalini

See the discussion under Clythrini, from which tribe these beetles are distinguished by the antennæ being usually long and slender, and by the prosternum extending between the front coxæ. We have six or eight genera and numerous species, most of which are "variegated with various combinations of spots or stripes which are sometimes very inconstant, so that numerous varieties have been named." One of the variable and common species is *Cryptocephalus venustus*. As its generic name indicates, its head is hidden, the prothorax covering it above. It is nearly .25 in. long and, in the typical form, the head and pronotum is reddish-brown, the latter having a narrow edging and two oblique spots yellow; the elytra are yellow, each with two broad, oblique, black or brown stripes. It is found on potato and other garden, as well as wild, plants.

### Eumolpini

The beetles of this tribe are usually of a uniform metallic color, although some are dull yellow or spotted. Their

head is visible from above although the pronotum comes about to the eyes; the outline of the eyes is more or less indented; the antennæ are usually thread-like and widely separated at their bases; the front coxæ are globose and separated by the prosternum; the third tarsal joint is deeply bilobed; the claws, toothed or cleft. The following key will help to identify eight of the genera. For the most part our species are not over .25 in. long.

1. **Front** ventral margin of thorax curved, forming lobes behind or below the eyes. (Only those beetles, belonging here, whose elytra are not pubescent or scaly are considered further).....2.

**Front** ventral margin of thorax straight.....3.

2. **Elytral** punctures in distinct, regular rows; middle and hind tibiæ indented on outer edge near apex. *Typophorus*. *T. canellus* is quite common on a variety of plants and sometimes injurious to strawberries, raspberries, etc. It is exceedingly variable in color and markings, reddish-yellow and black being the usual elements. About all that can be said here is that it is not .2 in. long and bright blue (*T. viridicyaneus*), nor has it a saddle-shaped, black space on the elytra (*T. sellatus*).

**Elytral** punctures irregular; tibiæ not indented. See Plate LXXXI. Usually common on dog-bane..... *Chrysochus auratus.*

3. **Side-margins** of pronotum not distinctly flattened....4.

**Side-margins** of pronotum distinctly flattened.....6.

4. **Not** metallic above; head without a groove above the eyes.....5.

**Metallic** green or bronzed above; head with a groove above the eyes. *Graphops*. The larvæ of *G. nebulosus* live in the roots of strawberries.

5. **Front** femora with a small tooth; third joint of antennæ not longer than the second. On oak and other trees.....*Xanthonia.*

**Femora** not toothed; third joint of antennæ longer than the second. On grape and Virginia creeper....*Fidia.*

6. **Head** with distinct grooves above the eyes; middle and hind tibiæ indented near apex. On oak and other trees..... *Metachroma.*

**Head** without grooves above the eyes.....7.

7. **Pronotum** about one-half wider than long, the sides rather broadly curved, angles prominent; dull brownish- or reddish-yellow; length usually not over .25 in. Adults on various garden plants; larvæ on roots of grape..... *Colaspis brunnea.*

**Sides** of pronotum straight. *Nodonota* (third joint of antennæ distinctly longer than the second, the last five joints not abruptly wider) and *Chrysodina.*

## Chrysomelini

These oval, convex beetles are usually of moderate size and variegated in color. The antennæ are of moderate length (see p. 363), the outer joints somewhat enlarged; the eyes are not prominent and their outline is feebly indented; the pronotum has well-defined side-margins; the elytra cover the abdomen.

*Phyllodecta* is distinguished by the tarsal claws being toothed or bifid, and the tibiæ neither dilated nor toothed.

The genera mentioned in this paragraph have the third tarsal joint indented or bilobed. Species of *Prasocuris* are usually not over .25 in. long; upper surface brassy-green, or bronzed-black, with yellow stripes; pronotum without a thin margin at the base. *Plagiodera* (punctures of elytra in regular rows; tibiæ not grooved on the outer side) and *Gastroidea* (punctures confused; tibiæ grooved) have the sides of the pronotum thickened and unicolorous elytra. *G. cyanea* is uniform, brilliant, green or blue, and feeds on dock (*Rumex*); *polygoni* is like it but the pronotum, legs, base of antennæ, and tip of abdomen are reddish, and it feeds on knot-grass; both are about .2 in. long. The pronotum of *Lina* is thickened at the sides and the elytra are usually spotted; length, .25 to .4 in. The pronotum is dark metallic green, with yellow sides, in *scripta* and *interrupta*. The elytra are usually reddish in life, fading to yellow, with rounded black spots, which are sometimes merged into transverse bands (*interrupta*) or are longitudinally elongate (*scripta*). Both feed on willow, and *Populus*, and both, sometimes, have the elytra wholly dark-colored. *L. tremulæ* is an introduced European species with a green pronotum and unspotted, dull yellow

elytra. The pronotum of *L. obsoleta* has reddish margins enclosing a rounded, black spot, or is reddish with 3 or 4 black spots at the center; elytra purplish-black with the margins, tips, and often two short, indistinct lines on basal half, reddish-yellow.

The third tarsal joint of the following genera of this tribe is not, or scarcely, indented; the pronotum has a thin margin at the base; the insects are usually more than .25 in. long, robust, and convex.

*Labioderma clivicollis* feeds on milkweed. It is dark blackish-blue; elytra orange-yellow with variable, broad, curved, black markings; mesosternum prominent, forming a blunt tubercle between the middle coxæ; front femora of male strongly toothed.

*Leptinotarsa* has simple femora and the mesosternum is not raised above the level of the prosternum. *L. decemlineata*, the Colorado Potato Beetle (Plate LXXXIII), is probably the most known Coleopteron in America. The elytral punctures are confluent and in double rows. Until about 1855 it was confined to the Rocky Mountain region where it fed on the wild relatives of the potato. Then man introduced potatoes to it, and it did the rest, spreading over the entire East. Adults hibernate underground. Each female lays about 500 eggs and there are two generations a year. In the South there is another species, *juncta*, which is somewhat similar but the third and fourth black bands on each elytron are usually united at the base and apex; the elytral punctures are regular and in single rows.

In *Zygogramma* the tarsal claws are parallel and united at the bases; claw-joint toothed beneath. The adults of *suturalis*, which occur on ragweed in the spring and on golden-rod in the fall, are brown, feebly bronzed; elytra yellow with dark brown stripes, or *vice versa*.

The elytra of our *Chrysomela* are without spots and the sides of the pronotum are thickened. Like *Calligrapha*, the last palpal joint is not shorter than the next to last.

The elytra of *Calligrapha* have dark markings and the sides of the pronotum are not thickened. To mention a few of the many variable species, first taking those with yellow and brown stripes on the elytra: *lunata* (chiefly on

roses; median brown stripe of each elytron more or less divided by yellow) and *similis* (chiefly on ragweed; that stripe merely notched on the outer side) have the pronotum wholly brown; it is partly yellowish in *præcelsis* (the median brown spot on pronotum reaching the base) and in *elegans* (this spot not reaching the base of the pronotum; chiefly on *Bidens* and *Ambrosia*). Of those with irregular spots on the elytra: the pronotum is wholly dark in *philadelphica* (suture pale but with, among other markings, a line each side of it; chiefly on dogwood), in *scalaris* (sutural stripe branched; a large crescentic shoulder-spot enclosing a small dot, and, back of it, 6 or 8 small dots, on each elytron; chiefly on elm and linden), and in *rhoda* (sutural stripe branched; each shoulder-crescent usually enclosing two spots; chiefly on hazel); the pronotum is yellow with reddish-brown spots in *multipunctata* (chiefly on *Cratægus*), and olive-green or brown, with pale apical and side margins, in *bigsbyana* (on maple, willow, and alder).

## Galerucini

The beetles of this tribe are usually more oblong and have softer elytra than those previously considered (see also p. 363). The head is exposed; the third antennal joint usually smaller than the fourth; hind femora not unusually thick; hind tibiæ usually without terminal spurs. The following are the genera most likely to be noticed.

**Galerucella** One of the "usuallies," above, was for this genus; the third joint of the antennæ is longer than the fourth. The antennæ are at least half as long as the body; pronotum has a median and two lateral impressions; front coxal cavities open behind; tibiæ ridged on the outer side and without terminal spurs; first joint of hind tarsi not longer than the next two; tarsal claws bifid in both sexes. There are about a dozen species in New Jersey, for example, and different species, for the most part, live on different plants but the one which attracts attention is *luteola*, the Elm-leaf Beetle (Plate LXXXI). Yes. It is another foreigner. Most injurious species are immigrants; the principal reason for their becoming injurious is that their special enemies, which

held them in check at home, did not come with them. *G. luteola* came in at Baltimore about 1834. The adult hibernates beneath bark, in cracks in buildings, and in other shelter. It may go into hibernation quite yellow and come out very dark green. The orange-yellow eggs are laid in clusters on the lower side of a leaf and the larvæ feed on the lower side also, gradually skeletonizing the leaf. When two or three weeks old, they enter the ground and pupate, emerging as adults in about a week. Usually it is the adults of the second annual brood which hibernate. Hints as to some of the other species may be gained from their food-plants. The following have stripes (often narrow and indistinct, especially in *americana*) on their elytra: *americana* is found on golden-rod; *notulata*, on rag-weed (*Ambrosia*); and *notata*, on *Eupatorium*. The following have no elongate, dark markings on the elytra: *cavicollis* is found on peach, plum, and cherry; *rufosanguinea*, on *Azalea; nymphæa*, on water-lilies; *tuberculata* and *decora*, on willow.

Among others, *Trirhabda* may be distinguished from *Galerucella* by having the third antennal joint shorter than the fourth; and the antennæ of *Monoxia* do not reach the middle of the body, tarsal claws bifid only in males.

**Diabrotica**

Two species are familiar to gardeners. *D. 12-punctata* (Plate LXXXIII) is called the Southern Corn Root-worm because its larvæ live in the roots of corn (and other grasses) and are sometimes quite injurious in the South. It is called the Twelve-spotted Cucumber Beetle because the adults eat cucumber leaves, but they feed also on melons of various kinds. The hibernating adults are among the first insects to appear in the spring and the last to take shelter in the fall. The Striped Cucumber Beetle, which feeds also on all the melon family, is *D. vittata* (Plate LXXXIII). The larvæ live in the roots and in the base of the vine of cucumbers, melons, etc. Adults hibernate in the ground. *D. atripennis* (elytra black) and *D. longicornis* (elytra green or yellow, without black margins) have the outer edge of their tibiæ ridged. The latter species is called the Western Corn Root-worm.

**Cerotoma trifurcata**

Head, scutellum, and under side of body black; pronotum and elytra dull yellow, rarely reddish; each elytron, usually but not always, with black basal and side margins, the latter extending nearly to the apex, and with three black spots close to the suture, the hind one the smallest; antennæ and the legs yellow, the tibiæ and often the femora, in part, black; length about .17 in. Common on peas, beans, and other Legumes.

## Halticini

"A large group of small or medium-sized leaf-eating forms, distinguished from the preceding tribe mainly by the fact that the hind thighs are greatly enlarged and thickened for leaping. As a consequence they are known as 'flea-beetles' or 'jumping beetles,' this term being especially applied to the small black species of *Haltica* and *Epitrix*, which are very injurious to vegetation in the mature or adult stage."

*Œdionychis* (last joint of hind tarsi globosely swollen). *Haltica* (a feeble transverse impression on basal half of pronotum; each hind tibia with a short, terminal spur), *Disonycha* (first joint of hind tarsus short as compared with the tibiæ, and rather broad; beetles distinctly more than .17 in. long), and *Phyllotreta* have the frontal coxæ open behind.

**Disonycha**

The following two are the garden species. *D. triangularis:* black (with a faint bluish tinge on elytra) except for the pronotum, which is yellow with a pair of round, black spots and a small, linear one; length, about .25 in.; on a variety of plants, sometimes injurious to beets and spinach. *D. xanthomelæna:* resembles the preceding but, among other things, is usually smaller, has the pronotum entirely yellow, the elytra with a greenish tinge, and the abdomen yellow; it feeds upon a number of wild plants but is known as the Spinach Flea-beetle.

**Phyllotreta**

The hind tibiæ are not grooved on the outer edge, but slightly excavated near the tip and with a spur at the middle beneath. *P. vittata* (Plate LXXXIII) is common all summer on cabbage and other Cruciferæ. The fifth joint of the antennæ is longer than either the fourth or the sixth; the male has the fifth antennal joint thickened.

**Haltica**

The two common, garden species are distinguished from the others by having no longitudinal fold along the sides of the elytra; by the antennæ and legs being black; and by a deep groove which extends completely across the pronotum in front of the base. *H. chalybea* is the Grape Flea-beetle. It is usually not less than .17 in. long; metallic blue, rarely greenish; pronotum distinctly narrowed in front. *H. ignita* is usually not more than .17 in. long; color varies from a coppery-golden lustre, through greenish, to dark blue; pronotum only slightly narrowed in front. In addition to feeding on a variety of wild plants it attacks strawberries and roses.

The following have the front coxal cavities closed behind; the last joint of the hind tarsi is not inflated, usually slender, although sometimes thickened in a side view. The antennæ of *Blepharida* are 12-jointed, instead of 11; tarsal claws bifid. *Chætocnema* has the hind tibiæ sinuate near the apex and with a distinct tooth on the outer margin. *Epitrix* (elytra with rows of stiff hairs) and *Crepidodera* (elytra without hairs; antennæ shorter than the body) have a distinct transverse impression in front of the base of the pronotum. The following lack such an impression: *Dibolia* (hind tibial spur broad, emarginate, or bifid at apex), *Mantura* (pronotum with a short, deep longitudinal impression on each side near the base), and *Systena* (pronotum without any impression).

**Chætocnema**

*C. confinis* is the species likely to be noticed first. It feeds on sweet-potato, morning-glory, and other Convolvulaceæ. It is less than .07 in. long; black, slightly bronzed; antennæ and legs,

except hind femora, reddish-yellow; pronotum obliquely cut off at the front angles and with an angulation in front of the middle. *C. pulicaria* is locally common and sometimes injurious to corn and millet. It is about the same size; black, with faint greenish or bluish-bronzed lustre; the base of antennæ and tibiæ and tarsi yellowish; side of pronotum regularly curved and the front angles not cut off; head without punctures, but a row along the basal margin of the pronotum.

**Crepidodera**

Only *rufipes* need be mentioned here. It is about .1 in. long; head, pronotum, and legs dull reddish-yellow; elytra dark blue; there are no punctures on the pronotum. On locust (*Robinia*), and sometimes injurious to grape, peach, apple, and other fruit trees.

**Epitrix**

Again we have two garden species. *E. cucumeris* is not over .08 in. long; shining black, with reddish-yellow antennæ and legs, except the hind femora. The pronotum is not densely punctate and the impression in front of the base is well marked. It is the Cucumber Flea-beetle but is not at all choice in its food, eating also the leaves of potato and other plants. In *E. parvula* the pronotum is rather closely punctate and the impression is scarcely visible. It is about the same size and dull reddish-yellow. The adults feed on the leaves of potato, tomato, and egg-plant, but do their greatest damage by eating holes in tobacco leaves. The larvæ feed on the roots of common weeds, such as the nightshade and Jamestown weed.

**Systena**

And, finally, we note this pair. *S. hudsonias:* length, .17 in.; shining black except for the yellow third to fifth antennal joints. Common on many plants. *S. tæniata:* length, about the same; color variable, usually reddish-or brownish-yellow, shining; each elytron with a paler, median stripe; narrow side-margins of pronotum and under side of body usually black. Adults occur on various plants, including cultivated ones.

## Hispini

See p. 363. Most of the larvæ live *in* leaves, feeding on the tissue between the two surfaces. See in this connection the Micro-lepidoptera and *Brachys*. The first three segments, back of the head, of a Hispine larva are wider than the rest of the body.

*Microrhopala* (antennæ either thread-like or the last 4 joints united into an oblong mass; elytra not, or only feebly, ridged) and *Octotoma* (the last 2 antennal joints enlarged; elytra with short, oblique folds) have 8 or 9 antennal joints. The others have 11, and some of them may be separated as follows.

1. **Elytra** ridged.....2.

**Elytra** not ridged; body elongate. *Stenispa. S. metallica* is a uniform, shining black, slightly bronzed; length .2 in. The pronotum of *collaris* is red; length slightly over .25 in.

2. **Middle** tibiæ strongly curved.....*Charistena.*

**Middle** tibiæ straight. *Chalepus*, also called *Odontata*. The following species are about .25 in. long, except as noted.....3.

3. **Each** elytron with ten rows of punctures; ridged.....4.

**Each** elytron with eight rows of punctures; color varies from nearly uniform rose-red to nearly black, with a few indistinct reddish or yellowish spots; legs pale; length about .17 in. On locust.....*Chalepus nervosa.*

4. **Each** elytron with only three ridges.....5.

**Each** elytron with three ridges, and a fourth (at base and apex) between the second and third. See Plate LXXXIII. On locust (*Robina*), basswood, and other trees.....*Chalepus rubra.*

5. **Elytra** wholly black; pronotum wholly red.....*Chalepus bicolor.*

**Elytra** black, with red shoulders; pronotum red, with a dark center.....*Chalepus scapularis.*

**Elytra** and pronotum scarlet, fading to yellowish, with a black, sutural line which becomes gradually broader as it reaches the apex. The larva makes a blotch mine on locust.....*Chalepus dorsalis.*

## Cassidini

On account of their form, these are often called Tortoise Beetles. Many of them are beautifully colored in life, but the golden hues rapidly fade after death. The oval, flattened, prickly larvæ feed upon the surface of leaves. "The larvæ are almost as disagreeable as the adult beetles are attractive, but are nevertheless very interesting creatures. Each of them is provided with a tail-like fork at the end of the body which is almost as long as the body, . . . Upon this fork are heaped the excrement and cast skins of the larva, and when covered by this 'umbrella' it is with great difficulty that the larva is distinguished from a bit of mud or a bird-dropping. The manner in which this fork increases with the size of the larva is rather interesting. At each molt, the fæci-fork of the last stage is held upon the new fæci-fork, and in this way those of the different stages are telescoped, the one inside the other, and the stage of growth of the larva may be readily determined by the number of cast skins held on the fork. From the likeness of this burden to a pack, the larvæ are often known as 'peddlers.' In order to more firmly bind the excrement and cast skins to the fork, the larvæ fasten them together by a fine network of silken threads, which are attached to the spines at the sides of the body. When fully grown the larva fastens itself to a leaf, its skin splits open along the back, and from it comes the pupa, which is held to the leaf by its caudal fork, which is securely incased in the fæci-fork of the larval skin" (Sanderson). The adult hibernates. Unless otherwise stated, the following feed chiefly on sweet-potatoes and other Convolvulaceæ.

**Chelymorpha cassidea** This has also been called *argus*. The front of the pronotum is incurved, partially exposing the head; upper surface red or yellow, with four or six black dots on pronotum, and six on each elytron in addition to a sutural one near the base; under surface black; length, about .4 in. The eggs are laid in bunches, each egg being supported by a long stalk or pedicle. When full-grown, the larva is about .5 in. long

with the fæci-fork half as long again, slightly convex, dirty yellowish, with numerous dark-brown tubercles and prominent lateral spines. The yellowish to black ground-color of the pupa is almost concealed by a bluish bloom or waxy excretion resembling mold. On milkweeds, *Convolvulus*, and, sometimes, raspberries.

In the following, the pronotum is rounded in front, covering the head; its side-margins are flattened (not thickened as in *Physonota*). The antennæ of *Cassida* do not reach beyond the base of the pronotum; those of *Coptocycla* extend beyond it. The names given are those in general use, as yet. Students interested in possible changes are referred to *Proc. Ent. Soc. Washington*, vol. xviii., page 113.

**Cassida**

*C. nigripes* is dull red or yellow after death; each elytron with three obscure black dots near the middle; base of antennæ, part of tibiæ, and tarsi, reddish, rest of legs and antennæ black. The eggs are laid in rows of three or more, so that several of the bright, straw-yellow larvæ, having two crescentic, black marks just back of the head and prominent, black-tipped spines, will be found together. The mass of excrement is usually much branched. The pronotum of *C. bivittata* is yellowish, with a large, triangular, brownish-red space at the base; elytra dull yellow, with the suture and two stripes on each black or dark brown; under surface and legs black. Eggs are usually laid singly. The cream-colored, with a longitudinal band along the back, larva (Plate LXXXIII) does not carry excrement but merely cast skins and holds them at an angle from the body, instead of close over the back.

**Coptocycla**

*C. purpurata* is usually not common in the North. It is less than .25 in. long, with unspotted, brownish-red elytra. *Coptocycla bicolor* (Plate LXXXIII) is common on bindweed. It is one of several "Gold-bugs." Harris said: "When living it has the power of changing its hues, at one time appearing only of a dull yellow color, and at other times shining with the splendor of polished brass or gold, tinged sometimes also

with variable tints of pearl. The wing covers, the parts which exhibit a change of color, are lined beneath with an orange colored paint, which seems to be filled with little vessels; and these are probably the source of the changeable brilliancy of the insect." Freshly emerged adults are dull orange and have three black dots on each elytron but, as the golden color is assumed, these spots disappear. After death, the elytra become dull reddish-yellow. Thanks to Mr. Leng, who sifted several hibernating adults from the fallen leaves in his garden just as the publishers were calling for "copy," I am able to give a figure colored from life—the only one which has been published, as far as I know. The under surface and last four joints of the antennæ are black; the flat margins of the pronotum and elytra are very thin and translucent. The egg has three spiny prongs; the larva's "pack" is trilobed in outline; the pupa is hidden by the larval pack and has three dark stripes on the pronotum, with similar markings over the abdomen. The following two have dark markings on the elytra. In *C. clavata* the disk of the elytra is quite rough from the numerous tubercles or elevations; base of pronotum and the elytra, except for the apices and the middle of the side margins, brown; under surface pale yellow; length, .3 in. The disk of the elytra of *C. signifera* is smooth; dull yellow; base of pronotum usually with a large, black spot, enclosing two pale ones; disk of elytra and shoulders black with irregular, yellow spots; length, not over .25 in. "The larva is a pale straw-yellow color during the first four stages when it carries excrement on the fæci-fork in a peculiar branched shape much like that of the black-legged tortoise-beetle larva, but after the last moult the color changes to a pea green, and all the excrement is removed from the fæci-fork, which makes the larva very difficult to recognize on a green leaf. In as much as the larva does not feed and remains entirely motionless during this last stage, this change of color is very evidently of protective value. The pupa is also a bright green, marked only by a ring around each of the first pair of abdominal spiracles" (Sanderson). The discal space on the elytra of *C. plicata* is shiny black, without spots.

## Bruchidæ

There are, relatively, not many of these beetles and, for the most part, they are less than .25 in. long. They differ from most of the Chrysomelidæ by having short, saw-toothed antennæ, and the tip of the abdomen is exposed. The larvæ live in seeds, especially of Legumes, and are often called "weevils"—a term which is confusing because of its application to the Rhynchophora. We have, all of us, eaten hundreds of the larvæ with our peas and beans, but—what's the difference? The eggs are usually laid upon the pod when the peas, for example, are quite small, and the young larvæ bore inside.

*Spermophagus* has two slender, jointed spurs on each hind tibia. The only Northeastern species, *robiniæ*, breeds in the seeds of the locusts (*Robinia* and *Gleditschia*). The adult is about .3 in. long; dull reddish-brown, clothed with grayish-yellow pubescence; elytra with small, black spots arranged in five irregular, transverse rows.

**Bruchus**

This is the large and common genus. The hind tibiæ are without jointed spurs and the prominent, front coxæ touch each other. Only two species (Plate LXXXIV) will be mentioned, but many others may be obtained either in ordinary collecting or, better because it gives food habits, by breeding from seeds of wild plants. *B. pisorum*, the Pea Weevil, has a notch on the middle of each side of the pronotum and a tooth on the outer side of each hind femur. It is black, densely clothed with reddish-brown and whitish hairs; pronotum with a triangular, whitish space in front of scutellum; elytra with yellowish, grayish, and whitish hairs. There is but one generation a year and this species does not breed in dry peas. The adult hibernates. The newly-hatched larva has legs but it loses these when it becomes a fat, sedentary grub. Pupation occurs within the seed. *B. obtectus*, the Bean Weevil, has no notch on the sides of the pronotum and each hind femur has two fine teeth in addition to a larger one near the tip. It is black, clothed with grayish-yellow pubescence; abdomen dull reddish-brown; antennæ black, the apical and four basal

joints reddish; legs reddish-brown, underside of hind femora black. In the field the eggs are laid upon, or are inserted in, the bean-pod, but eggs are also placed loosely among shelled beans. The larvæ and pupæ are much like those of *pisorum* but, unlike that species, more than one (28 have been recorded) may be inside a single seed. The life-cycle takes from three to twelve, or more, weeks, depending on conditions. Breeding is continuous throughout the year, if it is warm enough.

## HETEROMERA

The members of this series have five tarsal joints on each of the front and middle legs and only four on each of the hind legs.

1. **Front** coxal cavities closed behind....2.
   **Front** coxal cavities open behind....4.
2. **Tarsal** claws simple....3.
   **Tarsal** claws comb-like....CISTELIDÆ (p. 384).
3. **Next** to last joint of tarsi not spongy beneath....TENEBRIONIDÆ (p. 381).
   **Next** to last joint of tarsi spongy beneath; front coxæ prominent; last joint of antennæ at least as long as the three preceding joints combined....LAGRIIDÆ (p. 384).
4. **Head** not strongly and suddenly constricted behind the eyes....5.
   **Head** strongly and suddenly constricted behind the eyes....7.
5. **Middle** coxæ not very prominent....6.
   **Middle** coxæ very prominent; pronotum narrower at base than elytra, its sides rounded and without a sharp edge; next to last tarsal joint broad, slightly bilobed; body-covering rather flimsy in texture....ŒDEMERIDÆ (p. 385).
6. **Pronotum** margined at sides, broad at base, its disk (middle portion) with impressions near base; form usually elongate, loosely jointed; maxillary palpi usually long and pendulous, with the joints enlarged....MELANDRYIDÆ (p. 385).
   **Pronotum** not margined, narrower behind, disk not impressed at base; form usually long and narrow; head sometimes prolonged into a beak....PYTHIDÆ (p. 385).

7. **Pronotum** with a sharp edge at sides, its base as wide as elytra.....8.

**Sides** of pronotum more or less rounded and without a sharp edge.....10.

8. **Antennæ** thread-like.....9.

**Antennæ** with long, flat processes folding like a fan (male), or somewhat saw-toothed (female).....

*Pelecotoma* of the RHIPIPHORIDÆ (p. 393).

9. **Hind** coxæ with plates; head with vertex lobed or ridged behind, so that, when extended, it rests on the front edge of the pronotum; abdomen usually ending in a pointed process.....MORDELLIDÆ (p. 385).

**Hind** coxæ without plates; length less than .25 in.....Tribe Scraptiini of the MELANDRYIDÆ (p. 385).

10. **Pronotum** narrower at base than elytra.....11.

**Pronotum** as wide at base as elytra; the abdomen not ending in a spinous process; elytra usually shorter than abdomen and narrowed behind; antennæ comb-like in males, frequently saw-toothed in females.....

RHIPIPHORIDÆ (p. 393).

11. **Hind** coxæ not prominent; tarsal claws simple; antennæ thread-like and simple; head with an abrupt, narrow neck; length less than .5 in., usually less than .2 in.....ANTHICIDÆ (p. 386).

**Hind** coxæ large, prominent.....12.

12. **Tarsal** claws simple; head horizontal; antennæ usually branched in male, saw-toothed in female; next to last tarsal joints very broad....PYROCHROIDÆ (p. 386).

**Tarsal** claws cleft or toothed; front vertical; at least .25 in. long.....MELOIDÆ (p. 387).

### TENEBRIONIDÆ

These are the Darkling Beetles. There are many species in the Southwest, where they occur like Carabidæ, but they are by no means lacking in the East: New Jersey, for example, having more than sixty species. The eastern species are not usually found under stones, as are those in arid regions, but in dead wood, fungi, and dry vegetable products. The western Pinacate (*Eleodes*), "the bug that stands on his head," is a member of this family.

**Tenebrio**

The larvæ of *T. obscurus* (Plate LXXXIV) and *molitor* are the large Meal-worms, which have the distinction of being, probably, the only insects injurious to man's goods which are purposely bred on a large scale for commercial purposes. They destroy large quantities of flour, meal, cereals, and the like but are bred and sold for soft-billed birds to eat. The larvæ are hard, cylindrical, and strongly resemble wire-worms (Elateridæ). That of *obscurus* is about an inch long, when full-grown; yellow but shading off into yellowish-brown at each end and where the segments join. That of *molitor* is somewhat lighter. The pupæ are whitish and about .6 in. long; most of the abdominal segments have fringed side-expansions and the last one ends in two spines. The adults of both species are black or dark reddish-brown and about .6 in. long; *molitor* is shiny and *obscurus* is not. They are frequently attracted to lights. There seems to be, normally, but one generation a year, but in heated buildings this is not very definite. Related species occur under bark.

*Nyctobates pennsylvanica* is a black beetle, nearly an inch long, which is often common under the loose bark of dead trees. The genus differs from *Tenebrio* by the tarsal pubescence being fine and silky. The antennæ do not reach to the back of the pronotum, which is not narrowed at the base.

**Tribolium**

We have two species of this genus which occur in meal, grain, and other vegetable products. To give them a common name different from that applied to *Tenebrio*, they have been called Flour Beetles, but neither name is very distinctive. *Tribolium ferrugineum* is reddish-brown; its head is not expanded beyond the eyes at the sides; its antennal club is distinctly three-jointed; and its length is less than .2 in. Its "cousin," *confusum* (Plate LXXXIV), is darker; its head is expanded on each side in front of the eye; antennal joints gradually broader at tip. It has been recorded as breeding in pepper as well as in a variety of milder, starchy foods and it also eats the eggs and larvæ of other meal-feeding insects.

Bruchus obtectus

Bruchus pisorum

Tenebrio obscurus

Tribolium confusum

Boletotherus bifurcus

Nacerdes melanura

Mordella 8-punctata

The larvæ and pupæ are much like *Tenebrio* in miniature. Under favorable circumstances, a generation may be completed in five or six weeks and there may be several generations a year.

**Boletotherus** We have one species, *bifurcus*. It occurs, often in numbers, in woody, "bracket" fungi, such as grow on the sides of trees and stumps. The adults are black or brownish-black. What attracts attention are the horned males (Plate LXXXIV). A related genus, *Boletophagus*, is found with it, but more often under bark. In it each eye is completely divided and the antennæ are 11-jointed. There are two species, each not over .3 in. long and black: in *corticola* the pronotum has numerous tubercles, its margin is scalloped and, in front of the hind angles, deeply notched; in *depressus* the pronotum is merely coarsely punctured and its sides are evenly rounded.

*Diaperis maculata* is also common in hard fungi and under bark. It is about .25 in. long, oval and convex. The head and most of the elytra are reddish, otherwise black.

The species of CISTELIDÆ are like those of the Tenebrionidæ in general structure, but see the key (p. 380). They have longer, more slender antennæ and generally smooth, pubescent surface; they are usually brown in color with no, or only confused, maculation and often taper to a point posteriorly. They are found on leaves, flowers, and under bark, the larvæ, so far as known, living in rotten wood and somewhat resembling wire-worms in shape. None are of economic importance.

Of the LAGRIIDÆ (see p. 380) there are probably less than a dozen recognized species in the United States and only two genera. These species are black or bronzed, with rather thin, flexible elytra, and are found on flowers, leaves, or under bark of trees. For our purposes, we may say that our species of *Arthromacra* are about .5 in., and of *Statira* usually less than .3 in. long.

MELANDRYIDÆ (see p. 380) is another small family but it contains about ten times as many species as the preceding. They feed on fungi and dry vegetable matter, such as dead wood. *Penthe obliquata*, about .5 in. long, is velvety black with yellow on the scutellum; frequent under bark of dead trees.

About two dozen species of PYTHIDÆ (see p. 380) have been described from the United States. They occur under bark, especially of pine.

Of the ŒDEMERIDÆ, *Nacerdes melanura* (Plate LXXXIV) should be mentioned. It is a cosmopolitan beetle which is rather common in cities about cellars, old boxes, and lumber yards. It varies from .3 to .5 in. in length; dull yellow above, elytra tipped with blackish purple; each front tibia with one spur; next to the last tarsal joints broadly dilated. Other species are found on flowers, leaves, and sometimes in crevices of logs, trees, or stumps.

## MORDELLIDÆ

See p. 381. "This family includes a large number of small, wedge-shaped beetles having the body arched, the head bent downward and the abdomen usually prolonged into a style or pointed process. The hind legs are, in most species, very long and stout, fitted for leaping; the antennæ long and slender and the thorax is as wide at base as the elytra. The body is densely covered with fine silky hairs, usually black, but often very prettily spotted or banded with yellow or silver hues. The adults occur on flowers or on dead trees and are very active, flying and running with great rapidity and in the net or beating umbrella jumping and tumbling about in grotesque manner in their efforts to escape. The larvæ live in old wood or in the pith of plants, and those of some species are said to be carnivorous in habit, feeding upon the young of Lepidoptera and Diptera which they find in the plant stems" (Blatchley). The genus which has the most species in our region is *Mordellistena*. They are usually not over .25 in. long; their hind tibiæ have a distinct ridge

near the apex and usually one or more oblique ones; their eyes are coarsely granulated. The two following genera agree with it in having the last abdominal segment prolonged into a conical "style" and their tarsal claws comb-like, but their hind tibiæ have but a small ridge near the apex and their eyes are only finely granulated: in *Tomoxia* the style is short, obtuse, and the scutellum is usually indented behind; in *Mordella* (Plate LXXXIV) the anal style is long, slender, and the scutellum is triangular. Two other genera *Pentaria* and *Anaspis* (fourth joint of the front and middle tarsi smaller than the third) are not especially rare but they have few and small species; their abdomen is not prolonged at the tips and the tarsal claws are not cleft.

### Anthicidæ

Probably three hundred or more species are known from North America; more than a hundred new species were described in a single paper. They are, for the most part, small creatures with drooping heads; the key (p. 380) gives a number of technical points which distinguish them from related families. They are to be found on flowers, in rotten wood, and in burrows in sandy places near water. Some of them resemble ants and others have a prominent horn on the front part of the thorax. Of the latter sort: *Notoxus* has the hind tarsi not longer than the tibiæ; they are much longer than the tibiæ in *Mecynotarsus*. Our species of these genera are usually not over .25 in. long.

### Pyrochroidæ

See p. 381. Only a dozen or so species are known from the United States and they are not usually very common. The individuals are usually of moderate size with elytra rather soft in texture, usually widened behind the middle, and relatively long. The head is almost horizontal and constricted behind the eyes into a rather slender neck, both head and thorax being much narrower than the elytra. Most of our species have a reddish pronotum and

black or blue elytra. The antennæ vary from simple in some species, through saw-toothed, to comb-like or branched in the males of others. The larvæ have a broad head, stout legs, and two spines on the tip of the abdomen. *Dendroides* may be distinguished from other genera by having very large eyes which nearly touch each other.

### Meloidæ

Concerning this curious family, I take the liberty of quoting at some length from Sharp's excellent account of insects in the *Cambridge Natural History*.

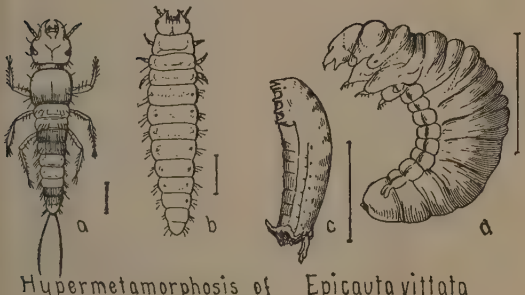
"This distinct family consists of Heteromera with soft integument, and is remarkable for the fact that many of its members contain a substance that, when extracted and applied to the human skin, possesses the power of raising blisters. The life-history is highly remarkable, the most complex forms of hypermetamorphosis being exhibited. The species now known amount to about 1500. . . . There are two very distinct subfamilies, Cantharides and Meloides; the former are winged Insects, and are frequently found on flowers or foliage. The Meloides are wingless, and consequently terrestrial; they have a very short metasternum, so that the middle coxæ touch the hind; and they also have very peculiar wing-cases, one of the two overlapping the other at the base; in a few Meloids the wing-cases are merely rudiments.

"The post-embryonic development of these Insects is amongst the most remarkable of modern entomological discoveries. The first steps were made by Newport in 1851, and the subject has since been greatly advanced by Fabre, Riley, and others. As an example of these peculiar histories, we may cite Riley's account of *Epicauta vittata* [See Plate LXXXV], a blister-beetle living at the expense of North American locusts of the genus *Calopternus* [*Melanoplus*]. The locust lays its eggs underground in masses surrounded by an irregular capsule, and the *Epicauta* deposits its eggs in spots frequented by the locust, but not in special proximity to the eggs thereof. In a few days the eggs of the blister-beetle hatch, giving rise to little larvæ [*a*] of the kind called triungulin, because each leg is

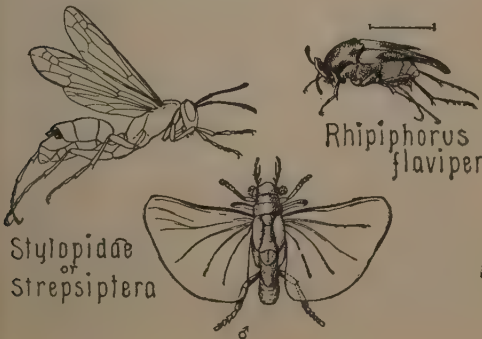
terminated by three tarsal spines or claws. In warm, sunny weather these triungulins become very active; they run about on the surface of the ground exploring all its cracks, penetrating various spots and burrowing, till an egg-pod of the locust is met with; into this the triungulin at once eats its way, and commences to devour an egg. Should two or more triungulins enter the same egg-pod, battles occur till one is left. After a few days passed in devouring a couple of eggs, the triungulin sheds its skin and appears as a different larva [*b*], with soft skin, short legs, small eyes, and different form and proportions; a second moult takes place after about a week, but is not accompanied by any very great change of form, though the larva is now curved, less active, and in form like a larva of Scarabæidæ; when another moult occurs the fourth instar appears as a still more helpless form of larva, which increases rapidly in size, and when full grown leaves the remains of the egg-pod it has been living on, and forms a small cavity near by; here it lies on one side motionless, but gradually contracting, till the skin separates and is pushed down to the end of the body, disclosing a completely helpless creature [*c*] that has been variously called a semi-pupa, pseudo-pupa, or coarctate larva; in this state the winter is passed. In the spring the skin of the coarctate larva bursts, and there crawls out of it a sixth instar [*d*] which resembles the fourth, except in the somewhat reduced size and greater whiteness. It is worthy of remark that the skin it has deserted retains its original form almost intact. In this sixth instar the larva is rather active and burrows about, but does not take food, and in the course of a few days again moults and discloses the true pupa. As usual in Coleoptera this instar lasts but a short time, and in five or six days the perfect beetle appears. It is extremely difficult to frame any explanation of this complex development; there are, it will be noticed, no less than five stages interposed between the first larval instar and the pupal instar, and the creature assumes in the penultimate one a quasi-pupal state, to again quit it for a return to a previous state. It is possible to look on the triungulin and the pupal instars as special adaptations to external conditions; but it is not possible to account for

Meloë angusticollis

Epicauta vittata marginata




Hypermetamorphosis of Epicauta vittata



Rhipiphorus flavipennis

Stylopidae or Strepsiptera

♂

E.B.

the intermediate instars in this way, and we must look on them as necessitated by the physiological processes going on internally. Nothing, however, is known as to these."

Fabre and others have described the European species of *Sitaris* living in much the same way at the expense of bees of the genus *Anthophora*.

**Meloë**

This is our only genus of the subfamily Meloinæ, or Meloides as it is called in the quotation from Sharp. The species are known as Oil-beetles; when disturbed, they give off a disagreeable, oily fluid. The short elytra do not nearly cover the over-sized abdomen. "The female Meloë is very prolific. She lays at three or four different intervals, in loose irregular masses in the ground, and may produce from three to four thousand eggs. These are soft, whitish, cylindrical, and rounded at each end. They give birth to the triungulins, which a few days after hatching—the number depending on the temperature—run actively about and climb on to Composite, Ranunculaceous, and other flowers, from which they attach themselves to bees and flies that visit the flowers. Fastening alike to many hairy Diptera and to Hymenoptera which can be of little or no service to them, many are doomed to perish, and only the few fortunate ones are carried to the proper cells of some *Anthophora*" (Riley). It is probable that different species of Meloë are parasitic on different species or even genera of bees. Our species may be differentiated as follows:

1. **Pronotum** not longer than wide.....2.

**Pronotum** longer than wide, sparsely and irregularly punctate; color deep bluish-black; elytra finely rugose; see Plate LXXXV.....*angusticollis.*

2. **Color** dull black; pronotum with an impression on basal half of median line.....*impressus.*

**Color** blue or bluish-black; pronotum not impressed..3.

3. **Pronotum** rather densely punctate; elytra not roughly sculptured.....*niger.*

**Pronotum** coarsely and deeply, not densely, punctured; elytra coarsely sculptured; color more decidedly blue and more shining.....*americanus.*

Some of our other genera, and the more important species, may be separated as follows:

1. **Front** not prolonged beyond the base of the antennæ; labrum (upper lip) small, scarcely visible. Tribe Horiini, of which *Tricrania sanguinipennis* should be looked for in sandy places. It is about .3 in. long; black, with brick-red elytra.

**Front** prolonged; labrum distinct.....2.

2. **Mandibles** prolonged beyond the labrum, acute at tip.....3.

**Mandibles** not prolonged, obtuse; elytra entire; antennæ straight, not thickened toward the apex. Tribe Cantharini.....4.

3. **Elytra** rudimentary; no wings; tarsal claws not cleft. Tribe Sitarini, to which *Hornia minutipennis* belongs. It is reddish-brown; length about .7 in.; parasitic upon a ground-bee (*Anthophora*).

**Elytra** entire; tarsal claws cleft. Tribe Nemognathini: *Nemognatha* has the outer lobe of the maxillæ (accessory jaws below or behind the mandibles) prolonged; it is not so in *Zonitis*.

4. **Second** joint of antennæ at least one-half as long as the third. *Macrobasis. M. unicolor:* .3 to .5 in. long; black, rather densely clothed with grayish hairs, which give it an ashy color; second joint of male's antennæ slightly longer than the next two and nearly twice as wide. The adults occur on various plants including potatoes and ironweed.

**Second** joint of antennæ much less than half the length of the third.....5.

5. **Next** to last joint of tarsi bilobed.....*Tetraonyx*.

**Next** to last joint of tarsi cylindrical.....6.

6. **Front** femora with a silken, hairy spot on the under side; second joint of antennæ very short; mandibles short. Larvæ, as far as known, feed on eggs of grasshoppers. *Epicauta*.....7.

**Front** femora without a silken, hairy spot.....13.

7. **Antennal** joints of equal thickness throughout, cylindrical, and closely united; eyes nearly as wide as long, feebly or not at all indented in front.....8.

**Antennal** joints on apical half more slender, loosely

united, and more or less compressed; eyes always longer than wide, indented in front.....10.

8. **Head** less densely punctured than pronotum, usually red behind the eyes, though often wholly black or with a small red spot in front; otherwise black, clothed with short, rather dense, black or gray pubescence, which often forms a marginal stripe and rarely a sutural line on elytra; length about .4 in. Adults on various plants, especially Convolvulaceæ.....*Epicauta trichrus.*

**Head** and pronotum similarly punctured, the former always black; elytra clothed with dense gray or grayish-yellow pubescence.....9.

9. **Pronotum** longer than wide, densely pubescent, with a dark line each side of the middle.....*Epicauta strigosa.*

**Pronotum** as wide as long, moderately shining, rather coarsely and densely punctured.....*Epicauta ferruginea.*

10. **Elytra** clay-yellow and black; see Plate LXXXV. See above for its biology. The adult shares with *Lema trilineata* the name of Old-fashioned Potato-beetle but feeds also on tomatoes and various weeds..*Epicauta vittata.*

**Elytra** without stripes on their middle.....11.

11. **Body**, beneath, clothed with gray pubescence; elytra in part or wholly pubescent.....12.

**Body,** above and beneath, wholly black; outer spur of hind tibia broader than the inner; length, .3 to .5 in. During autumn on goldenrod especially; sometimes injures garden asters.....*Epicauta pennsylvanica.*

12. **Elytra** wholly clothed with uniform, gray pubescence; length, .4 to .75 in. On potatoes and other plants.....*Epicauta cinerea.*

**Elytra** black, with gray margins and suture; see Plate LXXXV. May be only a variety of *cinerea*.....*Epicauta marginata.*

13. **Antennæ** thread-like, the outer joints cylindrical. *Pyrota.*

**Antennæ** thicker toward the apex, the outer joints oval or rounded. Two genera, which will probably not be noticed: *Pomphopœa,* with a deeply indented labrum; and *Cantharis,* with labrum only slightly indented.

### Rhipiphoridæ

See p. 381. "A small family of wedge-shaped beetles resembling the Mordellidæ in general appearance. . . . The adults occur on flowers and are much less common than the Mordellids. The larvæ that are known are parasitic, some in the nests of wasps and others on cockroaches" (Blatchley). See *Rhipiphorus flavipennis* on Plate LXXXV.

## RHYNCHOPHORA

This suborder, or series, has never been very popular. Furthermore, the taxonomy is difficult (possibly one of the main reasons for the unpopularity), and these two facts are sufficient excuse for giving short treatment here. Measurements of length are from the front margin of the eye or head (not the tip of the beak) to the hindmost part of the body. In giving the key to families, which is presented here in a slightly modified form, Blatchley and Leng say: "In using this key the student must remember that while the beak in many Curculionidæ is so long, slender, and curved downwards as to permit of immediately placing them in their family position, there are other species, especially in the Otiorhynchinæ, whose broader beaks would suggest their belonging to the Scolytidæ or Anthribidæ. In such cases, if the antennæ are elbowed, he must find the serrate [saw-toothed] tibiæ that characterize the Scolytidæ, or if straight, the flexible palpi that characterize the Anthribidæ; otherwise the specimen does not belong to those families."

1. **Beak** rarely absent, usually longer than broad; tibiæ never with a series of teeth externally.....2.

**Beak** absent or extremely short and broad; tibiæ with a series of teeth externally or, if these are wanting, with a prominent curved spine at apex; antennæ short, but little longer than the head, always elbowed and with a compact club; palpi rigid; body short, more or less cylindrical, rarely oval.....Scolytidæ (p. 404).

2. **Antennæ** straight, without a distinct club, though with the outer joints often more or less thickened; beak present,

at least in female, and pointing directly forward; form usually very slender and elongate.... BRENTHIDÆ (p. 394).

**Antennæ** straight or elbowed, always with a distinct club.....3.

3. **Beak** always short and broad; labrum (upper lip) present; antennal club rarely compact; palpi flexible; pronotum with a transverse, raised line at or near the base.....ANTHRIBIDÆ (p. 395).

**Beak** variable in length, often long and curved downwards; labrum absent except in the subfamily Rhinomacerinæ; antennal club usually compact; palpi rigid..... CURCULIONIDÆ (p. 395).

### BRENTHIDÆ

The only northern species seems to be *Eupsalis minuta* (Plate LXXXVI). It varies in length from about .25 to nearly .75 in. The color varies from reddish-brown to black; elytra with narrow, longitudinal, yellowish spots, which are often united to form two or three cross-bars. The length of the elytra is more than twice their combined width, and the pronotum is longer than broad. The mandibles of the male are curved, flattened, pointed, toothed on the inner edge; those of the female are small and pincer-shaped, at the end of a slender beak. The female uses this beak to bore deep holes in the wood beneath the bark of dead trees and she frequently takes the better part of a day at each hole, afterwards laying one egg in it. It is said that a male stands guard during the operation "occasionally assisting the female in extracting her beak; this he does by stationing himself at a right angle with her body, and by pressing his heavy prosternum against the tip of her abdomen; her stout forelegs serving as a fulcrum and her long body as a lever. When the beak is extracted, the female uses her antennæ for freeing the pincers or jaws of bits of wood or dust, the antennæ being furnished with stiff hairs and forming an excellent brush. Should a strange male approach, a heavy contest at once ensues, and continues until one or the other is thrown from the tree. The successful party then takes his station as guard" (Howard). The larvæ make extensive

galleries in the solid wood of oak, also of chestnut, maple, and other deciduous trees.

### Anthribidæ

Some recent authorities use the name Polystomidæ. These beetles are usually found on dead wood or on those fungi which grow on trees. Little is known of their life histories. *Eurymycter fasciatus* is about .3 in. long and has a conspicuous patch of white pubescence on the beak as well as a broad, white band across the elytra. *Brachytarsus sticticus* is not over .15 in. long, and breeds in the smut of corn and wheat. *Euparius marmoreus*, sooty brown mottled with gray, is very common on tough fungus on fallen logs, its color matching well with its surroundings.

### Curculionidæ

This is a very large family, more than 20,000 species having been described to date. The maggot-like larvæ have no more than bristly elevations for legs; the front part of the body is usually the thickest and, when at rest, the larvæ are usually curled like a C. Pupation usually occurs where the larvæ live but some species pupate in the ground. Thirteen subfamilies are recognized as follows:

1. **Antennæ** straight, the beak not grooved to receive them.....2.

**Antennæ** more or less completely elbowed, the beak grooved to receive them when at rest; antennal club compact.....9.

2. **Antennal** club composed of completely separated joints.....3.

**Club** composed of compactly united joints.....6.

3. **Thorax** without side margin.....4.

**Thorax** acutely margined and excavated beneath; three abdominal segments show beyond tip of abdomen. Pterocolinæ, of which only *Pterocolus ovatus* is known from the eastern United States. It is blue, less than .17 in. long.

4. **Labrum** present; palpi well developed, flexible; form elongate-oval. Feed on the staminate flowers of conifers. Rhinomacerinæ.

**Labrum** absent; palpi short, rigid.....5.

5. **Mandibles** flat, toothed on inner and outer sides; tibiæ with short terminal spurs at tip; claws free, bifid or acutely toothed; form usually elongate-oval, somewhat depressed. Rhynchitinæ. *Rhynchites bicolor* (elytra, pronotum and head, back of eyes, red, otherwise black; length .25 in.) breeds in the "hips" of roses.

**Mandibles** stout, pincer-shaped; tibiæ armed at tip with two strong hooks; claws united at base; form short-oval, robust.....Attelabinæ (p. 398).

6. **Tip** of abdomen covered by elytra; trochanters large, femora attached to their apex; form pear-shaped; not over .2 in. long. Apioninæ. There are many species of *Apion*, one of which is abundant in late summer on Wild Indigo. *Podapion gallicola* makes rather spherical galls on pine twigs, and is rare.

**Tip** of abdomen exposed; trochanters small.....7.

7. **First** joint of antennæ longer than the second.....8.

**First** joint of antennæ no longer than the second; beak short, broad; hind coxæ very widely separated; legs elongate, clasping; length less than .13 in. Tachygoninæ, the only genus being *Tachygonus*.

8. **Hind** femora very broad, their outer margin strongly curved, wrinkled; beak very slender, cylindrical; length about .14 in. Allocorhyninæ, *Allocorhynus slossoni* from Florida being the only known eastern species.

**Hind** femora normal; beak short and broad; length .5 in. or more. Ithycerinæ, the large *Ithycerus noveboracensis* being the only known eastern species.

9. **Antennal** club usually ringed, not shining; tarsi usually dilated, third joint bilobed, brush-like beneath, though narrow and setose in some more or less aquatic species; abdomen of male with an extra anal segment.....10.

**Antennal** club with its basal joint usually enlarged or shining or both, feebly or not at all ringed; tarsi frequently narrow, not brush-like beneath.....12.

10. **Prosternum** simple, or grooved to receive the beak, not forming a triangular plate in front of the coxæ.....11.

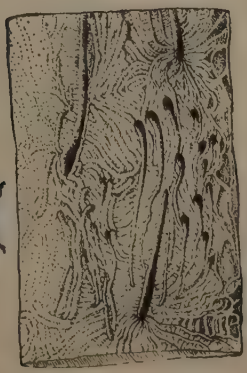
Conotrachelus nenuphar

Balaninus proboscoideus

Calandra larva

Calandra oryzae

Eupsalis minuta



Attelabus rhois

Scolytus rugulosus

**Prosternum** forming a triangular plate in front of the coxæ; beak received in the breast in repose; tarsi narrow, not dilated. Thecesterninæ. *Thecesternus humeralis* of the Mississippi Valley is the most eastern, known species.

11. **Beak** never long and slender; mandibles with a deciduous cusp, leaving a scar.....Otiorhynchinæ (p. 399).

**Beak** usually elongate, slender or, if short and stout, received in the breast in repose.... Curculioninæ (p. 400).

12. **Tip** of abdomen covered by elytra. Cossoninæ. The shining, black species of *Cossonus*, about .25 in. long, are sometimes found in numbers under bark.

**Tip** of abdomen not covered by elytra.....
Calandrinæ (p. 403).

## Attelabinæ

This is a small family of small beetles. The larvæ feed on the inside of "houses" prepared for them by their mothers. Pupation is said to take place underground. I quote concerning *Attelabus rhois* (Plate LXXXVI) from the Fifth Report of the U. S. Entomological Commission, a most excellent account of insects injurious to forest and shade trees by A. S. Packard. "The singular thimble-like rolls of this weevil may be found in June and July on the alder, and also occur on the hazel, according to LeConte [I have found them in large numbers on hazel]. When about to lay her eggs, the female begins to cut a slit near the base of the leaf on each side of the midrib, and at right angles to it, so that the leaf may be folded together. Before beginning to roll up the leaf she gnaws the stem nearly off, so that after the roll is made, and has dried for perhaps a day, it is easily detached by the wind and falls to the ground. When folding the leaf, she tightly rolls it up, neatly tucking in the ends, until a compact, cylindrical solid mass of vegetation is formed. Before the leaf is entirely rolled she deposits a single egg, rarely two, in the middle next to the midrib, where it lies loosely in a little cavity. While all this is going on her consort stands near by and she occasionally runs to him to receive his caresses, to again resume her work." As we have but a single genus, *Attelabus*, and the habits are so interesting,

a modification of Blatchley and Leng's key to our species is given.

1. **Surface** shiny; color, above, either mainly bright red or black.....2.

**Surface** pubescent; dull red (rarely blackish in the melanic northern form); length about .2 in.....*rhois*.

2. **Elytra** bright red (except see *analis*).....3.

**Black,** faintly bluish, with a reddish spot on each shoulder; length usually not .17 in.; front femora with a small, acute tooth. Nests in April and May, on oak....*bipustulatus*.

3. **Front** femora slender, not toothed in male; elytra, pronotum, base of head, prosternum, and abdomen bright red (variety *similis* is darker); rest of body, including appendages, blue-black; length rarely less than .2 in. It rolls the leaves of oak, possibly also of sumac, hickory, and walnut.....*analis*.

**Front** femora stout, two-toothed in males; color like *analis* except that all of the under surface of the body is usually dull red; length usually less than .2 in. Sumac is probably its only food-plant although adults occur on oak and other trees.....*nigripes*.

## Otiorhynchinæ

Some authors give these insects the rank of a family, Psallidiidæ. The deciduous cusps of the mandibles, mentioned in the key to subfamilies, are teeth which are probably useful to the beetle in getting out of the pupal case. They are soon lost but leave a "scar," often difficult to make out, on the front of each mandible. Of the numerous species, the following deserve special mention.

*Epicærus imbricatus* is a little less than .5 in. long; greenish-brown; when fresh, there is a median, longitudinal stripe of white scales on the pronotum, two irregular, white cross-bands on the elytra; the under surface and legs are nearly white. The adult feeds on a variety of plants, sometimes defoliating strawberries.

Species of *Otiorhynchus* have two short, fixed spurs on each hind tibia; the tarsi are dilated, spongy-pubescent beneath, the third joint deeply bilobed; the eyes are

rounded or slightly oval; the beak is as long as the head, more or less dilated, and notched at the tip. *O. sulcatus* and *ovatus* have the hind femora distinctly toothed. *O. sulcatus* is brownish-black; about .3 in. long; the femoral tooth is small and acute; the prothorax is rather cylindrical; elytra with small, remote patches of short, yellowish hair; the tip of the beak has a forked ridge. The larva eats off the roots of strawberry and, in greenhouses, other plants. It is usually not so troublesome in this way as *ovatus*, which is shiny black with reddish-brown legs and antennæ; length a trifle less than .25 in.; the femoral tooth large; tip of beak not ridged; prothorax rather globose; short, yellowish hairs on the prothorax and also on the elytra. Neither species have wings and both occur also in Europe. The adults have a troublesome habit, shared by some other weevils, of nibbling at tender shoots, causing serious damage at times to ornamental shrubs.

## Curculioninæ

This subfamily contains the great majority of the species, only a few of which can be mentioned here.

*Hypera* [*Phytonomous*] *punctata* is the Clover-leaf Beetle. The larvæ hibernate in the stems and among the old leaves of clover.

Many species of *Listronotus* and *Hyperodes* feed on aquatic plants.

The genus *Balaninus* contains the Nut and Acorn Weevils. The species have a bulky body and a long, slender beak, which is longer than the body in the females of some species. It is used for drilling holes in nuts or acorns in order that eggs may be placed in the kernel. The mouth parts at the end of the beak work vertically, instead of horizontally. Davis has noted that squirrels are fond of eating the larvæ, slightly opening many acorns, only to discard them if no larvæ are present. *B. proboscideus* (Plate LXXXVI) is .3 in., or more, in length (the beak is not included in these measurements); dark brown, densely but irregularly clothed with yellowish, scale-like hairs; the second antennal joint longer than the third; the beak of the female often nearly twice as long as the body. The

female lays its eggs in chestnuts by drilling a hole through the burr. When the nuts fall, the larvæ leave to hibernate underground, pupating the next July. The Lesser Chestnut Weevil, *B. algonquinus*, is rarely .33 in. long; black, with brownish scales; pronotum with a paler line near each side; elytra with numerous, pale, yellow spots, which sometimes form bands; second antennal joint shorter than the third; beak of female nearly twice as long as the body. It usually lays its eggs in the chestnuts after the burrs are opened and the larvæ remain there all winter, unless eaten. *B. caryæ* is the Hickory-nut and Pecan Weevil. The adult is about .3 in. long; brownish, with sparse, yellowish hairs. *B. obtusus* is the Hazel-nut Weevil. The infested nuts fall early. Most of our other species feed on acorns. *B. rectus* has a beak which, in the female, is nearly twice the length of the body but in the other acorn-eating species the beak is relatively shorter. *B. rectus* has "the habit, not known in the other species, of sealing the egg-hole with excrement, thus forming a whitish spot."

*Tachypterus* [*Anthonomus*] *quadrigibbus* is the Apple Curculio. It is dark red; about .17 in. long; pronotum with three lines of white pubescence; each elytron with two prominent tubercles toward the back. The larvæ feed for about three weeks in the flesh of green apples and pupate there. Even more damage is done by the adults which feed on tender shoots or puncture the ripening fruit in order to feed, causing it to become "dimpled and gnarled." Adults hibernate.

*Anthonomus signatus* is the Strawberry Weevil. It is not over .13 in. long. The injury is done by the females, which lay their eggs in the strawberry buds and then cut the stems so that the buds fall to the ground. *Anthonomus grandis*, the Cotton-boll Weevil, has cost Texas alone more than $150,000,000. It is a Mexican insect that spread northward throughout practically the whole of the cotton belt, due to the short-sightedness of legislatures in neither appropriating sufficient money nor passing stringent enough laws to control it at the start.

*Ampeloglypter sesostris* is pale reddish-brown, about .12 in. long. It lays its eggs in grape canes, giving rise to galls about twice the diameter of the cane and an inch

or so long, with a deep scar on one side. There are usually a number of these galls in a row. *A. ater* is much like it, but black. Its female also lays her eggs in grapevines but, instead of putting them in a longitudinal line, she deposits them in a circle around the cane, girdling the vine so that it breaks off.

*Trichobaris trinotata* is about .14 in. long; black, with white, scale-like hairs, except on the scutellum and two spots on the pronotum. Its larva is the Potato-stalk Borer but it also lives in nettle.

*Craponius inæqualis*, the Grape Curculio, is not over .13 in. long; dark brown, with scattered patches of whitish hairs. The hibernated adults feed on grape leaves until the berries are about a fourth grown when the female lays her eggs in them, the larvæ feeding on the seeds, and dropping to the ground to pupate under stones, and the like, or just below the surface.

*Ceutorhyncus rapæ* larvæ live in the seed stalks of cabbage but more often in wild Crucifers.

*Conotrachelus nenuphar* (Plate LXXXVI) is the Plum Curculio but it breeds also in peach, cherry, and apple, causing an annual loss in the United States of more than $8,000,000. It is about .25 in. long; dark brown, varied with black; pubescence brownish-yellow, forming a curved, forked line on each side of the pronotum; an elytral band of yellow and white hairs back of the middle. "The adults hibernate, and issue from their winter quarters about the time the trees are in bloom, feeding on the tender foliage, buds, and blossoms. Later they attack the newly set fruit, cutting small circular holes through the skin in feeding, while the females, in the operation of egg-laying, make the small, crescent-shaped punctures so commonly found on plums and other stone fruits. The egg, deposited under the skin of the fruit, soon hatches into a very small whitish grub, which makes its way into the flesh of the fruit. Here it feeds greedily and grows rapidly, becoming, in the course of a fortnight, the fat, dirty white 'worm' so well known to fruit growers. When the larva obtains full growth, which requires some twelve to eighteen days, it bores its way out of the fruit and enters the soil, where it forms an earthen cell in which to pupate."

Strawberry plants are often dwarfed or killed by the larvæ of *Tyloderma fragrariæ*, which mine out the interior of the crown.

## Calandrinæ

This rather small group, also called Rhynchophoridæ, of usually large (relative to other Curculionidæ) beetles are the Bill-Bugs and Grain-Weevils. The larvæ of the larger species bore into the stems of plants; those of the smaller ones feed on seeds and grain. *Rhynchophorus cruentatus* is usually more than .75 in. long, shiny black or partly red, and lives in the cabbage palmetto of the Southern States. It is the largest of our species. The antennal club is wedge-shaped in *Rhodobænus* (third tarsal joint broad, spongy beneath, the brush narrowly divided) and *Sphenophorus* (this joint smooth, at least in the middle); the species of each are .2 in., or more, long. The antennal club of *Calandra* is oval, and the species are smaller. *Rhodobænus 13-punctatus* is black beneath; above, red with five black spots on the pronotum and a number of more or less confluent ones on the elytra. It breeds in the stems of a variety of weeds. An allied species attacks sugar cane in the West Indies.

**Sphenophorus**

There are a large number of species, and their differentiation is difficult. "The corn bill-bugs (or 'clephant bugs'), as the species of *Sphenophorus* are commonly called, pass the winter in the imago [adult] stage among dead leaves and rubbish, and lay eggs early in the following summer, beginning probably in May. The larvæ hatch in June, feed on the bulbous roots of grasses and grass-like plants, including corn, pass into the pupal stage in July, and begin to emerge as imagoes late in July, continuing into August and possibly for some time thereafter. The normal food plants are wild grasses, especially those with bulbous roots" (Blatchley and Leng).

Calandra

Two cosmopolitan species may be mentioned. *C. granaria*, probably the first beetle to attract man's notice, is about .13 in. long; chestnut-brown to black, moderately shining; the pronotum with coarse, oval punctures; the elytra with small punctures in the longitudinal grooves. It is wingless and is found about granaries or wherever grain goes. The larvæ live inside the kernels, a single grain of wheat being food enough for one. This does not sound very destructive, but the females are prolific and there are from three to probably more than six generations a year. Authorities have estimated that its food costs us about twenty million dollars a year. *C. oryzæ* (Plate LXXXVI) is called the Rice Weevil and is probably a native of India but now infests all sorts of stored grain in this country. It is less than .13 in. long; reddish-brown to black, not shining; each elytron with two reddish spots. It is more apt to be found in crackers and packages of cereals than is *granaria*.

### Scolytidæ

The U. S. Department of Agriculture has stated that if the timber destroyed by Scolytidæ in the United States during the past fifty years were living to-day, its stumpage value would be more than $1,000,000,000. For the most part, these beetles live between the bark and the wood, making galleries which are often quite characteristic of the particular species that fashioned them and which cause the insects to be called Engraver Beetles. The insects are small and their taxonomy is difficult. The eyes are usually oblong (see Bostrychidæ). The following subfamilies have been recognized.

1. **Anterior** tarsi with the first joint longer than the next three combined. Platypodinæ, of which our only genus is *Platypus*. They frequently come to light in the Southern States.

**Anterior** tarsi with first joint shorter than the next three combined ..... 2.

2. **Anterior** tibiæ with a prominent process on the outer apical angle ..... Scolytinæ.

**Anterior** tibiæ without such a process ..... Ipinæ.

*Scolytus rugulosus* (Plate LXXXVI), the Fruit-tree Bark-beetle, is typical of the Scolytinæ. The numerous small "worm-holes," which make the outside of the bark look as if it had received a load of shot, are formed by the adults in boring out. Each female then burrows in at a new place and eats a vertical tunnel partly in the bark and partly in the sap-wood. Along the sides of this tunnel she makes small pockets and puts an egg in each. The young larvæ tunnel at right angles to the "broad burrow" and each pupates at the end of its own burrow. When the adults emerge from these pupæ, they bore straight out and so give the tree the "shot" appearance. If the insects are very numerous, their galleries girdle the tree and it dies, although it happens that this particular species usually works in trees that are dying from some other cause. *S. 4-spinosus* terribly damages the hickory trees near New York and its "bird-shot" emergence holes are a common sight.

The subfamily Ipinæ contains most of our species. Their food-habits are various but they usually live in trees, some in the solid wood instead of just beneath the bark. It should be said that many, especially those living in diseased wood, seem to feed more on the fungus ("ambrosia") which grows in their galleries than they do on the wood. Probably emerging females carry, but not intentionally, the spores of these fungi when they leave their childhood homes to start new establishments.

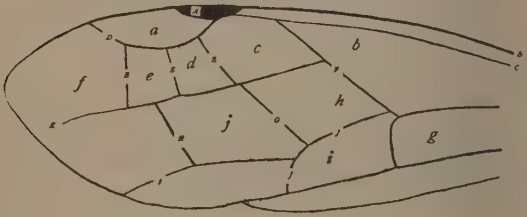
## STREPSIPTERA

These curious creatures are put in a separate order, as here, by some good authorities, while others class them as a family, Stylopidæ, of heteromerous beetles. They are all parasitic upon other insects. The females are wingless and Plate LXXXV shows one sticking out of the abdomen of a wasp. The same plate shows a typical winged male, greatly enlarged.

## HYMENOPTERA

To the layman these are the Saw-flies, Ants, Bees, and Wasps; the last-mentioned name referring principally to the Vespoidea and Sphecoidea, and only in a hazy way to the large number of other Hymenoptera which are neither ants nor bees. The State Geological and Natural History Survey of Connecticut has recently published a large *Guide to the Hymenoptera* of that State by H. L. Viereck and others. The more special students of taxonomy are referred to this and from it I have drawn freely for the few remarks on classification which space permits us.

The notes on wing-venation refer to the front wings. The following names (see the text-figure) are the ones




used here: *A*, stigma; *B*, costal vein; *C*, subcostal vein; *D*, marginal vein; *E*, transverse cubital veins; *F*, basal vein; *G* and *H*, first and second recurrent veins; *I*, subdiscoidal vein; *J*, discoidal vein; *K*, cubital vein; *a*, marginal cell; *b*, median cell; *c*, *d*, *e*, and *f*, first, second, third, and fourth submarginal or cubital cells; *g*, submedian cell; *h*, *i*, *j*, first, second, and third discoidal cells.

Hymenoptera are divided into a number of superfamilies, which may be roughly characterized as follows, the order not being natural but for convenience.

(*a*) TENTHREDINOIDEA.—No marked constriction between the thorax and abdomen, the abdomen being broadly joined to the thorax; trochanters (the part between the basal joint and the long femur) two-jointed. Saw-flies; see p. 408.

In the groups *b* to *j* there is a marked constriction between the thorax and abdomen, the two being joined by a relatively thin stem (petiole or pedicel), which may be either very short or long.

(*b*) CHALCIDOIDEA.—Usually less than an eighth of an inch in length and metallic in appearance; trochanters two-jointed; antennæ elbowed, with one or more ring-like segments between the shaft and lash; wings, if any, with but few veins; wingless forms with indistinct or no ocelli; female's ovipositor issuing from the ventral surface of the abdomen some distance before the tip. See p. 414.

(*c*) SERPHOIDEA.—The Pelecinidæ have one-jointed trochanters; abdomen, and also antennæ, long and slender; black; front wings with no closed submarginal cells. The others have two-jointed trochanters; body not metallic, usually black with sometimes brown or red; antennæ straight or, if elbowed, without the ring-like segments; the wingless forms with distinct ocelli; ovipositor issuing from the tip of the abdomen. See p. 415.

(*d*) CYNIPOIDEA.—Trochanters two-jointed; antennæ with not more than 16 joints; front wings, if present, without stigma (a thickening of the costal vein at about two-thirds of the way along the front margin of the front wing) but usually with one or more closed cells; antennæ straight; body "flea-like." See p. 414.

(*e*) ICHNEUMONOIDEA.—Trochanters two-jointed (except in rare forms); antennæ with more than 16 joints; front wings, if present, with a stigma and one or more closed cells; antennæ straight. See p. 411.

In groups *f* to *j* the trochanters are always one-jointed.

(*f*) CHRYSIDOIDEA.—Only three abdominal segments visible; bright green, bluish, or golden; antennæ short and elbowed; front wings with no closed submarginal cells. See p. 424.

(*g*) FORMICOIDEA.—First apparent abdominal segment (sometimes also the second) forming a lens-shaped

scale or knot, strongly differentiated from the rest of the abdomen. (In what follows I will leave off the word "apparent"; really the first abdominal segment of all but the Tenthredinoidea is so closely fused to the thorax that it does not appear as part of the abdomen and may, for practical purposes, be forgotten.) The Formicoidea are the True Ants and the workers are always wingless. See p. 415.

In groups *h* to *j* the petiole is not scale-like or nodiform; body often hairy.

(*h*) APOIDEA.—First segment of hind tarsus (basi- or metatarsus) expanded, flattened, and usually very hairy; trochanters one-jointed; many of the hairs branched; adults always winged. Bees; see p. 439.

In groups *i* and *j* (as well as in other Hymenoptera which are not bees), the basitarsus is not as described for bees and the body-hairs are not branched.

(*i*) VESPOIDEA.—Pronotum extending back so that its hind angles or tubercles touch or reach above the tegulæ (scale-like bodies, one in front of the base of each wing); wingless forms are densely hairy; some of the winged forms fold the front wings longitudinally when at rest. See p. 425.

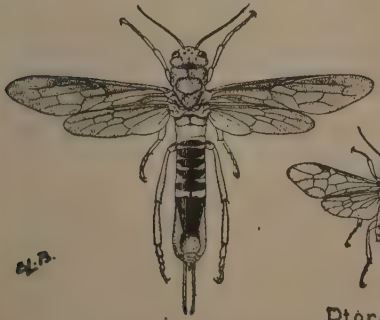
(*j*) SPHECOIDEA.—Hind angles of pronotum remote from tegulæ and on a lower level (this is true also of the bees); never wingless; front wings never folded. See p. 431.

## TENTHREDINOIDEA

The ovipositor of the female Saw-fly consists of an external, flattened plate on each side ("saw-guides") and two flattened, pointed, yellowish plates ("saws") between them. The larvæ either feed on the leaves of plants or within their stems, including tree-trunks; some of them make galls. Saw-fly larvæ have only one ocellus on each side of the head, whereas caterpillars have several; also their abdominal legs, if present, do not have the circles of hooklets possessed by Lepidoptera. The larvæ of Siricidæ and Cephidæ are practically legless; when saw-fly larvæ have abdominal legs, there is always a pair on

Cimbex americana

Neurotoma fasciata



Tremex columba

Pteronidea ribesi

the fifth segment; larvæ of some of the Tenthredinidæ have as many as eleven pairs of legs, including those on the thorax.

Our few species of XYELIDÆ may be known by their antennæ: the third of the more than three segments usually being longer than all the following segments put together. The larvæ feed externally on various trees.

The hind margin of the pronotum of the PAMPHILIIDÆ is scarcely indented. A common species is *Neurotoma fasciata* (Plate LXXXVII) whose larvæ web the leaves of wild cherry.

In the following families the pronotum is frequently so indented that the middle portion seems absent.

The anterior tibiæ of the TENTHREDINIDÆ have two apical spurs, while those of the following families have but one. This is a very large family, including most of the saw-flies. The following notes on larval food-habits are merely suggestive: *Diprion* on conifers; *Dolerus* are grass-feeders; *Endelomyia æthiops* is a common rose-leaf pest; *Calichroa cerasi* is the cherry and pear "slug"; *Cimbex americana* (Plate LXXXVII) is the big, white larva, common on willow, also found on elm, poplar, and linden; *Cladius pectinicornis* on roses in spring, also on clematis; *Diphadnus appendiculatus* is the Gooseberry Saw-fly; *Euura* and *Pontania* make galls on willow; *Pteronidea ribesi* (Plate LXXXVII) is the common Currant-worm, also on gooseberry; *Monophadnoides rubi* is the Raspberry Saw-fly; *Erythraspides pygmæa* on grape.

The antennæ of the ORYSSIDÆ are situated just above the mandibles under a transverse ridge which conceals their bases. The larva of *Oryssus sayi* bores in maple.

The CEPHIDÆ are slender saw-flies of rather soft texture. The larvæ of *Janus integer* tunnel the pith of currants; of *Adirus trimaculatus* bore in the stems of blackberry; and of *Cephus pygmæus* in wheat.

The XIPHYDRIIDÆ are moderate-sized creatures with quite a long neck; the ovipositor is cylindrical; the last dorsal plate of the abdomen (see Siricidæ) does not end in a triangular or lance-shaped process.

The SIRICIDÆ are the Horn-tails. The last dorsal plate of the abdomen ends in a triangular or lance-shaped process. These insects are wood-borers and sometimes emerge in our houses from fire-wood or even furniture.

**Tremex columba**

The adult Pigeon Tremex is well represented in Plate LXXXVII. It is also called Horn-tail. The cylindrical larva, with three pairs of legs near its head and a "horn" near the other end, bores in the trunks of diseased maple, elm, and other trees. It pupates in the larval burrow after making a cocoon of silk and chips. On emerging, the adult leaves a hole about the diameter of a lead pencil.

## ICHNEUMONOIDEA

This is one of the most important groups of insects, from an economic standpoint, but the classification of its species is no task for any but the specialist. Many millions of these ichneumon "wasps" are working every year, with the assistance of other parasitic insects, in keeping down insect pests and insects which might be pests. To be sure, others, as "secondary parasites," prey upon the foes of our foes, and it is one of the problems of professional economic entomologists to know one from the other; but in this group so much depends on the general looks of a species, its "habitus," that experience and named collections are necessary to easy identification.

The easiest family to recognize, in a general way, is the EVANIIDÆ; the abdomen appears to be joined to the top, instead of to the end, of the thorax. *Evania urbana* and *appendigaster* (Plate LXXXVIII) have blunt abdomens and breed in the eggs of cockroaches.

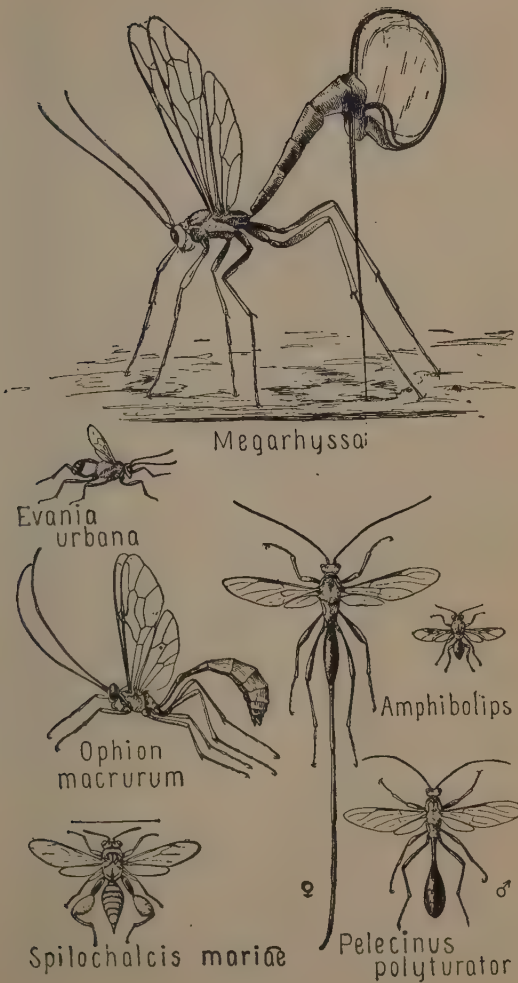
Plate XXXVIII shows the cocoons of one of the BRACONIDÆ on a Sphingid caterpillar. The larvæ live

within the caterpillar but come out and pupate just before their host dies. Bunches of such cocoons are often found fastened on plants; these belong to species which leave their host before pupating. Other species live in plant-lice, pupating within their host's dead body and cutting a neat, circular hole through the abdominal wall when emerging. Usually a member of the superfamily Ichneumonoidea which has no more than two apparent, dorsal, abdominal segments is a Brachonid, especially if the cutting edge of the mandibles be turned inwardly.

The family ICHNEUMONIDÆ includes the largest and most frequently noticed species. The first abdominal segment is broadened or bulbous, not cylindrical. Frequently a promising Saturnid cocoon contains one of these, *Ophion macrurum* (Plate LXXXVIII), instead of its rightful owner. The *Ophion* larva, which was feeding inside the caterpillar, allowed its host to live until the cocoon was made, then killed the maker, spun a dense, brownish cocoon of its own as an additional protection, and pupated.

**Megarhyssa** A more commonly used name is *Thalessa*. Most of the female Ichneumonoidea carry their ovipositors protruding from the tip of their body, but the ovipositors in this genus are long, even when compared with the large size of insects. They are parasitic upon wood-boring larvæ, such as *Tremex*, and are, in turn, parasitized by *Ibalia*. Delicate as the ovipositor seems to be, the female is able, with it, to pierce solid wood in order to deposit an egg in the burrow of the *Tremex* within the tree's trunk (Plate LXXXVIII). I do not know how the females decide where to bore. The egg is not necessarily laid near the *Tremex* larva but the burrow must be reached and this is rarely, if ever, half an inch wide. Because of the popular interest in the subject, I assure you that the creature does not sting and give a modification of Mr. Viereck's key to some of our species.

1. **Wings** without dark patches.....2.
   **Wings** with dark patches; more than .75 in. long.....4.
2. **More** than .75 in. long; exserted portion of ovipositor usually at least twice the length of the body.....3.


Megarhyssa
Evania
urbana
Ophion
macrurum
Amphibolips
♀
♂
Spilochalcis mariæ
Pelecinus
polyturator

**Less** than .75 in. long; thorax and abdomen entirely black.....*nitida.*

3. **Female** mostly blackish, with fuscous (smoky) wings; male mostly dark brown, with a dark, median stripe or area on the hind end of the thorax.....*atrata.*

**Both** sexes mostly pale brown; wings not fuscous; abdomen with yellow, lateral stripes, at least in the female; male without the dark marking on the end of the thorax. *nortoni.*

4. **Exserted** portion of the ovipositor not much longer than the body; front wings not dark brown except in and near the marginal cell.....*greenei.*

**Exserted** portion of the ovipositor two times, or more, as long as the body; front wings dark brown along the basal vein and elsewhere.....*lunator.*

## CYNIPOIDEA

There are several families in this group, the largest and most interesting being the Cynipidæ. They are largely gall-makers; see p. 457 and *Amphibolips*, Plate LXXXVIII. Some Cynipoidea, such as *Ibalia*, the largest of our Cynipoids and parasitic on *Megarhyssa*, are parasitic; others, although breeding in galls, do not have any part in making them but merely feed on the plant tissue which grew because of the activities of another insect. Some of the Cynipid gall-makers have an interesting alternation of generations: adults of generation **A** produce a certain kind of gall from which hatches generation **B**; adults of **B** differ from those of **A** and make a different kind of gall but their offspring are **A**, starting the cycle over again. This matter has not been worked out for the American species.

## CHALCIDOIDEA

A few, such as *Isosoma*, the "joint-worms" of grain, are plant feeders. As a rule, they are parasitic, a large number of them being secondary parasites, that is parasitic upon parasitic insects. The fact that, in many instances, an individual gets its entire nourishment from a single

insect egg or a single scale-insect indicates the small size of many species. Others feed on larger prey as, for instance, *Pteromalus puparum* on the cabbage-worm. Only last week a small boy brought in numbers of the yellow *Spilochalcis mariæ* (Plate LXXXVIII) which had come out of *cecropia* cocoons he had gathered.

## SERPHOIDEA

This superfamily is made up of the PROCTOTRYPIDÆ and PELECINIDÆ of the older system of classification and is now divided into a number of different families. Almost, or quite, all are parasitic. Although they are nearly all small, some being, in fact, the smallest of our insects and practically invisible to the naked eye, *Pelecinus polyturator* (Plate LXXXVIII) is quite large. It is the only species of Pelecinidæ within the geographic limits of this book, and is parasitic upon the larvæ of May beetles, *Phyllophaga*. The elongate abdomen of the female enables her to reach the underground larvæ; the more normally shaped male is quite rare. The small Proctotrupidæ breed in the eggs of various insects, some even swimming with their wings under water to reach the eggs of aquatic forms.

## FORMICOIDEA

There is only one family, FORMICIDÆ, of Ants. In addition to males and sexual females, nearly every species has modified females, which rarely reproduce. These are the workers. There may be more than one sort of worker, in which case they are usually much alike except in size but some may be differentiated as "soldiers." It is the workers which we ordinarily see and, as they never have wings, many people think that all ants are wingless. However, the sexual forms, which are usually produced but once a year, are fully winged and indulge in a nuptial flight. After it, the males die but the females lose their wings and settle down to the stay-at-home task of producing offspring. The rearing of all except the first of these offspring is attended to by the old-maid daughters unless

the species has learned the trick of keeping servants ("slaves"). The pupæ of some species are enclosed in cocoons (the "ant's eggs" of commerce); those of others are naked.

Ants may be kept alive as pets. To do this, be sure that you secure a queen; many workers to take care of things are not required and, in fact, an unattended queen will often rear attendants, especially if she be young and fertile. Things go more smoothly if the workers have eggs, larvæ, and pupæ to start with. The simplest formicarium is a goblet set in a pan of water; in this case considerable earth is necessary and one can not well see what is going on. Janet used a plaster box much like the one described on p. 16 except that he had several communicating chambers; three covers are desirable: a glass one having a hole over each chamber (not strictly necessary), pieces of glass to cover each of these holes, and an opaque cover to all but one chamber (the feeding one). The Fielde nest is made from two pieces of glass, one for top and one for bottom; the walls are made from strips of glass (laid flat) or of heavy toweling, the feeding door being a plug of cotton; there should be an opaque cover for top and bottom of all but the feeding chamber; moisture is supplied by wetting a slice of sponge in the feeding chamber. A little soil (or rotten wood) may be put in the Janet nest and should be in the Fielde nest. Feed sugar, bits of meat, fruit, or something of the sort.

The habits of ants are both interesting and diversified. Of the many books devoted wholly, or in large part, to them, by far the best is Prof. W. M. Wheeler's, published by the Columbia University Press under the title of *Ants: Their Structure, Development, and Behavior.* The following key to the principal genera of our region refers only to workers and, since it does not include all of the genera, no surprise need be felt if all of your specimens do not fit. I hope they will not fit in the wrong place. Following it are a few notes to serve as starters. The key and notes are largely extracts from Wheeler's chapter in the Hymenoptera of Connecticut.

## KEY TO GENERA OF ANTS.

1. **Cloacal** orifice ventral, slit-shaped.....7.

**Cloacal** orifice terminal, circular, surrounded by a fringe of hairs; abdominal pedicel consisting of only a single segment; no constriction between the first and second gastric segments (The gaster is the swollen portion of the abdomen); pupæ usually enclosed in a cocoon. Camponotinæ.....2.

2. **Antennæ** 9-jointed.....*Brachymyrmex.*

**More** than 9 antennal joints.....3.

3. **Workers** strongly polymorphic, *i. e.*, some large-headed, some small-headed, and some intermediate.... *Camponotus.*

**Workers** not polymorphic though often of variable size.....4.

4. **Clypeal** depression (The clypeus is the lower part of the face; the labrum, or lip, is attached to it.) distinctly separated from antennal depression.....*Prenolepis.*

**Clypeal** depression confluent with antennal depression.....5.

5. **Second** to fifth joints of funiculus (the antenna beyond the first joint; the "lash") not longer than succeeding joints; ocelli usually absent.....*Lasius.*

**These** joints longer than the succeeding; ocelli distinct; fourth joint of maxillary palpi a little longer than fifth....6.

6. **Mandibles** with broad, dentate, apical border. *Formica.*

**Mandibles** narrow, falcate, and pointed..*Polyergus.*

7. **Sting** developed, sometimes very small but still exsertile; pedicel consisting of one or two segments (when of only one, a distinct constriction between first and second gastric segments).....9.

**Sting** vestigial; pedicel with one segment; no constriction between first and second gastric segments; often with a peculiar, rancid-butter odor; pupæ naked. Dolichoderinæ.....8.

8. **Chitinous** integument hard and brittle, often strongly sculptured; thorax and petiole often spinose or angular. *Dolichoderus.*

**Integument** thin and flexible, smooth or very finely sculptured; thorax and petiole unarmed; scale of petiole vestigial or absent.....*Tapinoma.*

9. **Pupæ** naked; abdominal pedicel consisting of two segments.....10.

**Pupæ** enclosed in cocoons; pedicel with one segment; gaster with a distinct constriction between its first and second segments; frontal ridges separated or, if close together, dilated to form oblique or horizontal plates partly covering insertions of antennæ. Ponerinæ, of which *Ponera coarctata* is our common species. It nests under stones and in rotten logs in open woods and along hedges.

10. **Frontal** ridges very close together, almost vertical, not at all covering antennal insertions; eyes always very small or absent; tropical or subtropical. Dorylinæ.

**Frontal** ridges of a different conformation and covering antennal insertions; eyes rarely vestigial or absent. Myrmicinæ. In the following, workers are developed and clypeus usually extends back between frontal ridges....11.

11. **Postpetiole** joined to upper surface of gaster, which is flattened above, more convex below, and pointed at tip. *Cremastogaster.*

**Postpetiole** joined to front end of gaster, which is of the usual shape; antennal club consisting of several joints, or antennæ not 11-jointed.....12.

12. **Antennæ** 10-jointed, with a 2-jointed club.. *Solenopsis.*

**Antennal** club, when developed, with more than two joints.....13.

13. **Posterior** margin of clypeus elevated in the form of a welt, bordering antennal depression in front; antennæ of workers with 11 (sub-genus *Xiphomyrmex*) or 12 joints, of male 10-jointed..... *Tetramorium.*

**Posterior** border of clypeus not thus elevated.....14.

14. **Antennæ** 11-jointed.....15.

**Antennæ** 12-jointed.....16.

15. **Thorax** and petiole without any traces of teeth or spines; pronotum never angular; petiole distinctly pedunculate..... *Monomorium.*

**Epinotum** (posterior part of thorax, above) armed with spines or teeth. *Leptothorax* (see 19); *Symmyrmica*, which fits here, may also be found.

16. **Workers** strongly dimorphic, usually without inter-

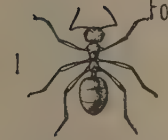
Monomorium pharaonis

Cremastogaster lineolata

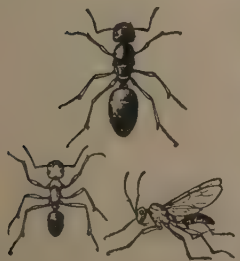
Tetramorium cæspitum

Formica schaufussi

Polyergus lucidus



Lasius niger var. americanus



Camponotus pennsylvanicus

Work $\frac{2}{3}$ nat.

mediates; antennal club 3-jointed, longer than remainder of funiculus.....*Pheidole.*

**Workers** monomorphic or polymorphic, *i. e.*, with intermediates; antennal club indistinct or shorter than remainder of funiculus.....**17.**

**17. Last** three antennal joints much shorter than remainder of funiculus and not forming a distinct club; back of thorax with an impressed suture.....**18.**

**Last** three antennal joints forming a distinct club nearly as long as remainder of funiculus.....**19.**

**18. Spurs** of hind tibiæ comb-like.....*Myrmica.*

**Spurs** of hind tibiæ simple; eyes well developed; no keels on clypeus; workers monomorphic..*Aphænogaster.*

**19. Clypeus** with a pair of ridges which usually project forward in the form of teeth.....*Monomorium.*

**Clypeus** of a different conformation, rarely 2-toothed; postpetiole constricted behind.....*Leptothorax* (see **15**).

*Monomorium pharaonis* (Plate LXXXIX) is the little red or yellow ant which is often abundant in our houses. A native of the Old World, it is now widely distributed. *M. minimum* is very small and jet-black. It makes small crater nests in sandy places. The workers move in files, visiting plants in search of honey-dew and the secretion of the extrafloral nectaries.

*Solenopsis molesta.* The minute, yellow workers are common in open, grassy places where they may have nests of their own under stones or they may tunnel the walls of nests belonging to larger ants, stealing their food.

*Pheidole pilifera* is a true harvesting ant, storing the chambers of its nests with seeds, especially of grass. The huge-headed soldiers undoubtedly function as seed-crushers.

*Cremastogaster lineolata* (Plate LXXXIX), in several varieties, is very common under stones, boards, etc. It often makes paper-like partitions in its nest or over aphids and coccids on plants—"cow sheds." The workers, which have a disagreeable odor, move about in loose files and often carry the triangular gaster over the thorax with the tip turned forward.

*Aphænogaster* (several species) is usually found in shady woods, in rotten wood, and under stones.

*Myrmica punctiventris* has coarse, scattered punctures on the first gastric segment; *scabrinodis* and its varieties have the antennal scape toothed or lobed at base; *brevinodis*, and its varieties, have the scape merely curved. The latter is host to species of *Leptothorax* and nests in bog-hummocks.

*Leptothorax emersoni* obtains its food by licking the surfaces and mouth parts of the *Myrmica* workers, and brings up its brood in little cells which communicate, by means of slender galleries, with the larger chambers and runways of *Myrmica*. *L. curvispinosus* nests in hollow twigs, empty galls, etc.; it is yellow, with two dark spots on the first gastric segment.

*Tetramorium cæspitum* (Plate LXXXIX), from Europe, occurs on lawns and in greenhouses.

*Dolichoderus mariæ* has a bright red head and thorax. It forms large colonies, nesting in sandy places about the roots of grasses and bushes. The workers ascend trees in files and attend aphids and coccids. The colonies of *D. plagiatus* are small; the head and thorax are coarsely punctate and the gaster has large, yellowish-red spots.

*Tapinoma sessile* nests under things, usually in sunny places. The larvæ and pupæ are salmon-colored.

*Brachymyrmex heeri depilis* is very small. It nests under stones in shady woods and attends coccids on the roots of plants.

*Prenolepis imparis* makes small crater nests in oak woods, especially on clayey soil. The workers visit trees for the purpose of attending aphids, obtaining the secretion of extrafloral nectaries, etc. After imbibing these liquids, the gaster often becomes so distended that it is four or five times its normal size and the insects walk with difficulty. In this replete condition *imparis* workers may be said to represent a temporary stage of the more extraordinary enlargement of the gaster seen in the honey ants (*Myrmecocystus*) of the Southwestern States and Mexico. The males and females of *imparis* often pass the winter in the parental nest and celebrate their nuptial flight early in the spring.

*Lasius niger americanus* (Plate LXXXIX) has 6-jointed maxillary palpi, the last three joints being elongated and

of nearly equal length; scapes and legs without erect hairs. "This ant, which passes in much of our entomological literature as *L. alienus*, is not only the commonest of our numerous species of *Lasius*, but the most abundant of our ants, and hence, of all our insects. It occurs over the whole of North America, except the extreme southern and southwestern portions, from timberline on the highest mountains to the sands of seashore. Even in circumscribed localities it shows, in its nesting sites, great adaptability to different physical conditions, from the damp rotten wood of dense forests to the sandy soil of dry, sunny roads. Usually the workers living in the latter stations are much paler in color than the woodland forms. The nests are indifferently under bark, logs, or stones, in rotten wood or in soil. When in the open soil, they are surmounted by small single or clustered craters. Like all of our other species of *Lasius*, *L. niger* var. *americanus* is much given to cultivating root aphids in the chambers and galleries of its nests; but, with the exception of the variety *neoniger* [scapes and legs beset with erect hairs], it is the only one of our forms that is not exclusively subterranean in its habits."

A few of the species of *Formica* may be separated as follows:

1. **Clypeus** with a notch in middle of anterior border. *F. sanguinea;* var. *subintegra* is light red, with brown gaster, and var. *rubicunda*, among others, is deep red, with black gaster.

   **Clypeus** without such notch.....2.

2. **Posterior** border of head broadly excised..... *F. exsectoides.*

   **Posterior** border of head not excised.....3.

3. **Body** rather stout; head of larger workers usually but little longer than broad; second to third funicular joints much more elongated than sixth to eighth; color red, with brown or black gaster.....4.

   **Body** more slender and graceful; head of larger workers distinctly longer than broad; second to third funicular joints but little more elongated than sixth to eighth; color rarely as in preceding.....5.

4. **Petiole** broad, with sharp upper border; body and lower surface of head without erect hairs ..... *F. truncicola integra.*

**Petiole** narrow, thick, and blunt above..... *F. difficilis consocians.*

5. **Middle** funicular joints more than one and a half times as long as broad; scape very slender and nearly straight; petiole with convex anterior and posterior surfaces, and blunt upper margin; body smooth and rather shining..... *F. pallide-fulva.*

**Middle** funicular joints usually less than one and a half times as long as broad; scape distinctly curved at base; posterior surface of petiole flat; body more densely pubescent..... *F. fusca.*

*F. sanguinea* usually nests under stones in grassy places along the edges of woods. It obtains slaves, or auxiliary workers, by kidnapping the larvæ and pupæ of *fusca subsericea.*

*F. exsectoides* occurs chiefly in the Alleghanies. It nests in and under mounds which it constructs of earth and vegetable debris. Not only are these mounds often three or four feet in diameter and a foot or two high, but a single colony often extends over several mounds. The females get a start by establishing their colonies in depauperate colonies of *fusca subsericea.* It feeds partly, at least, on dead insects.

*F. truncicola integra* is our largest and most conspicuous form of *truncicola.* The nests are in piles of large stones or in old logs and stumps; they are stuffed with bits of grass and leaves. Like most other species of *Formica*, *integra* is much given to attending aphids. It is most abundant in hilly regions, where it prefers clearings in the forests.

The females of *F. difficilis consocians*, which are yellow and hardly larger than the largest workers, are temporary parasites in the nests of *schaufussi* var. *incerta.* Soon after fertilization the queen seeks adoption in some depauperate and probably queenless colony of *incerta* and there permits her hosts to bring up her young. Later the *incerta* workers die off, leaving the *consocians* as a pure and independent colony, which grows rapidly in size and shows no evidence

of its parasitic origin. The nests resemble those of *integra* but are smaller.

The subspecies, *schaufussi* (Plate LXXXIX), of *F. pallide-fulva*, is yellowish or reddish-brown, gaster but little darker; it has erect hairs on the lower surface of the head and on the petiolar border. It is one of the commonest species of *Formica* and nests in rather small colonies under stones or in small, obscure mound-nests in sunny, grassy fields. Its food consists largely of dead insects and the excrement of aphids. See *Polyergus lucidus*.

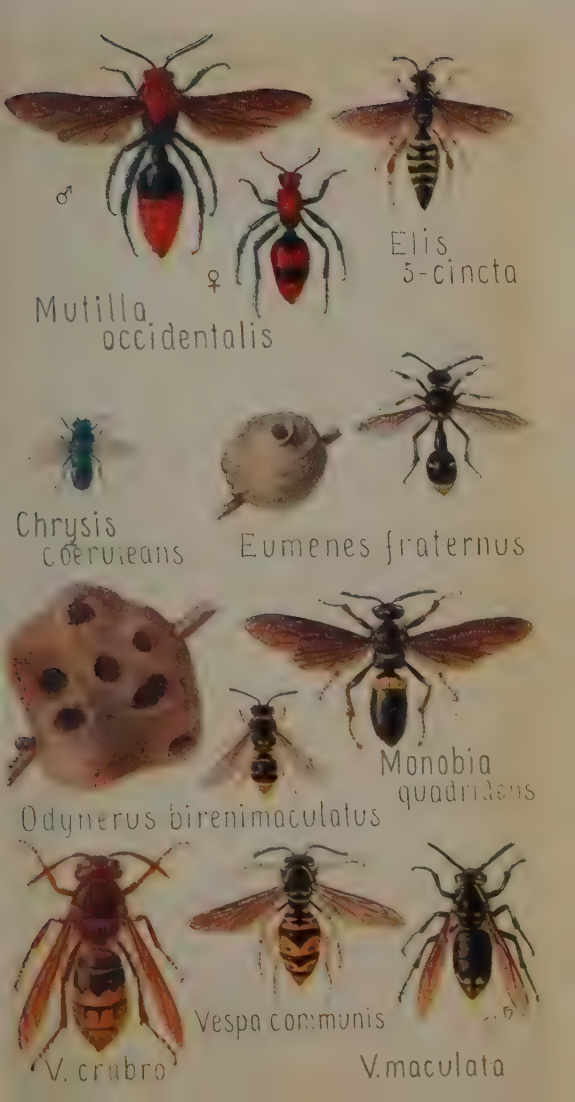
*Formica fusca* var. *subsericea* is extremely common. Its habits are much like those of *schaufussi* and, like it, *subsericea* is very timid. As the preceding notes show, it is a very convenient creature for its relatives.

*Polyergus lucidus* (Plate LXXXIX) is called the "shining slave-maker" or "shining amazon." Its slaves are bred from pupæ of *Formica schaufussi*, which are taken from their maternal nests by the warlike *lucidus* workers. The latter are quite unable to feed themselves, excavate their nests, or care for their own brood, but have to depend for these important activities on the *schaufussi* workers. Hence the ants of this species are quite unable to live an independent life and may be regarded as permanently parasitic on fragments of *schaufussi* colonies which they bring together with great skill.

The commonest *Camponotus* is *herculeanus pennsylvanicus* (Plate LXXXIX). It is the big, black Carpenter Ant, which usually nests in shady woods in old logs and stumps, whence it may migrate into old farm-houses and suburban residences. In such an event, it becomes a pest, both by riddling the wood-work with its large galleries and by hunting for sweets.

## CHRYSIDOIDEA

The scientific name refers to the golden color of certain (European) species and "Ruby Wasps" to the color of others, but most American species are metallic green or blue. "Cuckoo-wasps" is a name which describes their habits, since they lay their eggs in the nests of other Hymenoptera and their larvæ deprive the rightful owner of food, if they do not actually eat the owner first. The


♂
♀
Mutilla occidentalis
Elis 5-cincta
Chrysis coeruleans
Eumenes fraternus
Monobia quadridens
Odynerus birenimaculatus
V. crubro
Vespa communis
V. maculata

hind part of the abdomen is modified to form a retractile tube. The colors are extremely beautiful and well repay the use of a lens. We have but one family, CHRYSIDIDÆ. The following key to certain genera is practically that of the Hymenoptera of Connecticut.

1. **Tongue** not longer than thorax.....2.
   **Tongue** longer than thorax, bee-like.....*Parnopes.*
2. **Third** abdominal segment with grooves or pits near the margin; head at least as broad as postscutellum....
   *Chrysis* (Plate XC).
   **Third** abdominal segment without such grooves.....3.
3. **Tarsal** claw with 2 to 6 teeth besides apical one.....4.
   **Not** so.....5.
4. **Apical** abdominal segment produced as if pinched; apical margin of third abdominal segment indented, the indentations more or less filled with a membrane. *Notozus.*
   **Apical** segment not "pinched"; margin of third segment notched, rounded.....*Omalus.*
5. **One** small, perpendicular tooth in middle of tarsal claw..... *Hedychridium.*
   **Tarsal** claws cleft.....*Hedychrum.*

## VESPOIDEA

The typical "Wasps," Hornets, and their relatives, belong here.

1. **Winged**.....2.
   **Wingless**, or with wings much reduced in size.....10.
2. **Hind** wings without distinct venation, with no closed cells. Parasitic.....3.
   **Hind** wings with well-developed venation and closed cells.....4.
3. **Head** oblong, rather flat above; antennæ inserted at the clypeus, at least 12 joints; small, usually black or bronzed; females often wingless; abdomen more or less elongate.....BETHYLIDÆ.
   **Head** transverse or somewhat squared; antennæ 10-jointed; front tarsi of female usually pincer-shaped....
   DRYINIDÆ.

4. **Wings** folded longitudinally when at rest (They are indistinctly so in the MASARIDÆ of our West, which have the end joints of the antennæ thickened and more or less fused); first discoidal cell much longer than the submedian; antennæ distinctly elbowed.....5.

**Wings** not folded when at rest.....6.

5. **Middle** tibiæ with one spur at apex; tarsal claws with one or more teeth.....EUMENIDÆ (p. 428).

**Middle** tibiæ with two spurs at apex; tarsal claws simple.....VESPIDÆ (p. 430).

6. **Legs** long, the hind femora reaching to or beyond the apex of the abdomen; tibiæ and tarsi nearly always spiny or serrate; middle tibiæ with two spurs.....

PSAMMOCHARIDÆ (p. 428).

**Legs** of usual length.....7.

7. **A** strong constriction or transverse furrow between the first two segments of the abdomen, beneath.....8.

**No** such furrow; clypeus nearly, or quite, as long as wide; margin of eyes indented. SAPYGIDÆ. *Sapyga* is the only Northeastern genus; in *centrata* the yellow line on inner orbits extends beyond the top of the eyes, and in *americana* it does not. They are parasitic on bees and wasps.

8. **Middle** coxæ usually widely separated by a bilobed or triangular prolongation of the mesosternum; tibiæ usually flattened, with bristles exteriorly.....SCOLIIDÆ (p. 427).

**Middle** coxæ touching.....9.

9. **Hind** wings with an anal lobe, separated by a deep, narrow notch. With three submarginal cells and no upturned spine at apex of abdomen: male MYRMOSIDÆ; the only species in the Northeast is *Myrmosa unicolor*. With two submarginal cells and an upturned spine at apex of abdomen: METHOCIDÆ, of which *Methoca stygia* is the only northeastern species.

**Hind** wings without an anal lobe, at most obtusely indented; body hairy, the hairs often brightly colored.

Male MUTILLIDÆ (p. 427).

10. **Back** of thorax without visible sutures.....

Female MUTILLIDÆ (p. 427).

**Back** of thorax with one suture. Female MYRMOSIDÆ (see 9).

**Back** of thorax with two sutures.....11.

11. **Head** long, usually distinctly longer than broad, flattened above, the front horizontal; legs stout. Some female BETHYLIDÆ (see 3).

**Head** transverse, squared or rounded.....12.

12. **Antennæ** 10-jointed; front tarsi usually pincer-shaped. Some DRYINIDÆ (see 3).

**Antennæ** 12-jointed; front tarsi normal. METHOCIDÆ (see 9).

**Antennæ** 13-jointed; wings present as small pads. A few male MUTILLIDÆ (see below).

### SCOLIIDÆ

These hairy wasps burrow in the ground in search of the larvæ of May-beetles (*Phyllophaga*, etc.), on which their larvæ feed. The confusion of names need not concern us here. The following are some of the genera, named according to the Hymenoptera of Connecticut.

1. **Inner** margins of eyes indented; with yellow markings.....2.

**Inner** margins of eyes not indented.....4.

2. **Tarsal** claws cleft; middle tibiæ with two spurs. Eliinæ. *Elis* (Plate XC) is our only genus.

**Tarsal** claws simple; middle tibiæ with one spur. Scoliinæ.....3.

3. **Front** wings with two recurrent veins...*Campsomeris.*

**Front** wings with one recurrent vein.....*Scolia.*

4. **Middle** tibiæ with two spurs. Anthoboscinæ..... *Sierolomorpha.*

**Middle** tibiæ with one spur. Tiphiinæ.....5.

5. **First** transverse cubital present but incomplete. *Paratiphia*, our only Eastern species being *algonquina.*

**First** transverse cubital wanting. *Tiphia;* a number of species.

### MUTILLIDÆ

These are the Velvet Ants, pretty but the females certainly can sting. As far as the amateur is concerned, the Methocidæ and Myrmosidæ might as well be grouped

with them; they formerly were. The common name is well given. The wingless females of these wasps, scurrying about in open, especially sandy, places, look like ants covered with black, yellow, or red velvet. In the Southwest some of the species have long, white hair. The winged males can not sting; those of some species are often found about flowers, others are nocturnal. The two sexes of a given species usually have dissimilar markings. Most of these insects are unkind guests in the nests of other wasps and of bees. The old genus *Mutilla* (Plate XC) is now divided into a number of subgenera, one of which is *Dasymutilla*.

### Psammocharidæ

These are the Pompilidæ of older classifications. They are rather slender, long-legged, solitary wasps; usually black or blue, often with orange bands. The wings are usually black and kept jerking while the insect is running about. They prey chiefly upon spiders, the big *Pepsis* of the Southwest not stopping short of the "tarantula." Most of our species burrow in the ground to form their nests but others make cells out of mud, placing them under stones, etc., while the larvæ of some live in the nests of other diggers. *Ceropales* has the last-named habit; the genus may be recognized by the claws of the hind tarsi being bent at a right angle. Plate XCII shows *Psammochares atrox*.

### Eumenidæ

The Potter Wasps seem to me to exceed their immediate relatives, at least the solitary ones, in interesting habits. The nest of *Eumenes fraternus* (Plate XC) justifies the common name given to the group but all of the species seem to use clay more or less, even when their nests are burrows in the pith of plant-stems. This is an extensive family and, from an economic standpoint, of great importance to our farmers and fruit-growers, very few of whom know anything at all of the great benefit they are deriving every year from these brightly marked wasps. Their prey is

destructive Lepidopterous and Coleopterous larvæ, of which they must destroy many thousands every year. As with most solitary wasps, the prey is first paralyzed by stinging and then packed in the nest as food for the larva which will hatch from the egg laid before the nest is sealed. Certain genera may be separated as follows:

1. **Abdomen** petiolate.....2.
   **Abdomen** sessile, or nearly so.....3.
2. **Head** large, quadrate, much expanded behind the eyes, making the cheeks broad; clypeus broader than long, concealing the mandibles, when they are closed...*Zethus*.
   **Head** not expanded behind the eyes, which almost entirely cover the cheeks; clypeus longer than broad; mandibles, when closed, extending beneath the head like a beak.....*Eumenes*.
3. **First** abdominal segment funnel-shaped.....*Nortonia*.
   **Not** so.....4.
4. **Maxillary** palpi with 6 joints.....*Odynerus* (Plate XC).
   **Maxillary** palpi with less than 6 joints.....*Monobia* (Plate XC).

### Vespidæ

This is the family which is usually concerned when people speak of Wasps, Hornets, or Yellow-jackets. They are all social creatures (among themselves) that make nests of "paper" formed from chewed wood. In the South there is *Polybia*, whose abdomen is short and ovate beyond the first, petiolate, segment; several mothers unite in producing the young of a colony. We may, for practical purposes, group our northern species in two genera: *Vespa*, first abdominal segment very broad and sharply truncate in front; and *Polistes*, this segment long and gradually narrowed in front to a more or less distinct petiole. In these, each colony is a single family in which unmarriageable daughters help to build the house, keep it clean, and feed the younger children. The food consists of chewed-up animal matter, such as caterpillars, but some species use honey and pollen also. The larvæ are fed from day to day, or oftener, no food being stored for them.

**Polistes** This genus (Plate XCI) makes a broad, flat nest without a protecting cover. *P. pallipes* has an almost uniformly brown abdomen; *annularis*, a conspicuous, yellow margin on the first abdominal segment; and *variatus*, many yellow bands or spots.

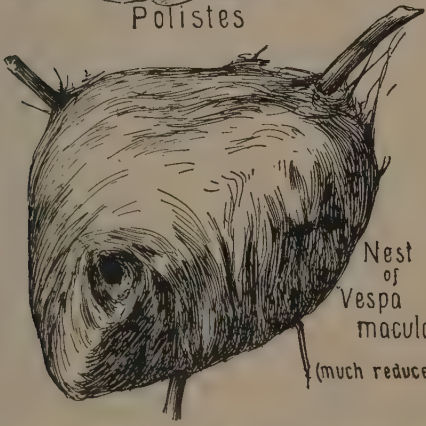
**Vespa** This genus makes a paper cover for the nests which are otherwise much like those of *Polistes*, except that there are a number of "floors." The large, gray hornet's nest, hanging on trees or from the eaves of houses, is that of *V. maculata* (Plates XC and XCI). At the start, this nest has a long, tubular entrance. An often equally large nest, but brown or yellow and usually placed in some protected spot such as in a hollow tree or under a porch-floor, is made by the European *V. crabro* (Plate XC), which was introduced, several years ago, near New York. The remainder of our species, the yellow-jackets, usually make smaller nests and place them either near or under the ground. In the latter case they usually start in a deserted field mouse's burrow. We have the following "Yellow-jackets" in the Northeast.

1. **Eyes** touching base of mandibles or separated from them only by a line ..... 2.
   **Eyes** remote from the base of the mandibles ..... 3.
2. **Black** and white ..... *arctica.*
   **Black** and yellow ..... *diabolica.*
3. **Black** and white ..... *consobrina.*
   **Black** and yellow..*communis* (including what has been called, in America, *germanica* and *vulgaris*). Plate XC.

## SPHECOIDEA

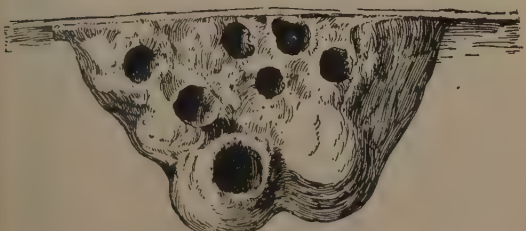
Dr. Bequaert kindly drew up the following key. It does not include the NITELIDÆ; they are small species and if a specimen of this family runs to couplet **2**, it may be recognized by the marginal cell having no appendix or the venation of the hind wings being almost absent; if it runs to couplet **10**, note that it has but one apical spur on each middle tibia and the second submarginal cell is petiolate. The Peckhams have written both accurately

Polistes



Nest of Vespa maculata

(much reduced)



Mud-dauber's nest

and entertainingly of *The Instincts and Habits of the Solitary Wasps*, as the Sphecoidea are called.

1. **Inner** margins of the eyes notched, eyes being kidney-shaped; one (rarely 2) distinct submarginal cells; marginal cell without an appendix; each middle tibia with a single apical spur.....TRYPOXYLONIDÆ (p. 436).

**Inner** margins of eyes not notched; when these are slightly indented, note 3 submarginal cells.....2.

2. **One** submarginal cell; marginal cell with an appendix; one, or no, apical spur on middle tibiæ.....3.

**Two** or 3 submarginal cells.....4.

3. **First** submarginal cell separated from the first discoidal; scutellum and post-scutellum without spines or scales; eyes divergent above.....CRABRONIDÆ (p. 434).

**First** submarginal and first cubital cells confluent; sides of scutellum with marginal lamellæ; postscutellum with a spine or forked process; eyes not divergent above. OXYBELIDÆ (p. 434).

4. **Abdomen** more or less constricted between the first and second segments; three submarginal cells; marginal cell without an appendix. PHILANTHIDÆ (p. 435). The rare MELLINIDÆ may be distinguished from them by having two apical spurs on each middle tibia, no recurrent nervure going to the second submarginal cell, and eyes never indented on the inner margins,

**Abdomen** not constricted between the first and second segments, but the first often shaped like a slender petiole.....5.

5. **Main** part of the abdomen joined to the thorax by a more or less distinct, slender petiole, which may be short or long, cylindrical or flattened above.....6.

**Main** part of the abdomen directly joined to the thorax (although there is a deep constriction between them); 3 (rarely 2) submarginal cells.....8.

6. **Middle** tibiæ with one apical spur; 2 or 3 submarginal cells; hind wings usually with two indentations in the basal half of the hind margin; small, black species..... PSENIDÆ (p. 434).

**Middle** tibiæ with two apical spurs.....7.

7. **Mesosternum** produced into a forked process posteriorly; pronotum conically produced in front; 2 submarginal

cells; marginal cell with an appendix; small, black species. AMPULICIDÆ. Rare. Our only genus is *Rhinopsis;* it may prey on roaches.

**Mesosternum** not produced posteriorly; pronotum not conically produced; 3 (rarely 2) submarginal cells; marginal cell without an appendix; shining black or marked with reddish-brown.....SPHECIDÆ (p. 438).

**8. Labrum** large, free, triangularly or semicircularly elongated beyond the clypeus; marginal cell rarely with an appendix; both recurrent nervures running to the second submarginal cell.....**9.**

**Labrum** small, not or scarcely extending beyond the clypeus.....**10.**

**9. Middle** tibiæ with a single apical spur; labrum much longer than wide; ocelli more or less aborted.....BEMBECIDÆ (p. 437).

**Middle** tibiæ with two apical spurs; labrum wider than long. STIZIDÆ. The only eastern species is *Sphecius speciosus* (Plate XCII). It is our largest Sphecoid and, because of the food with which it stocks its underground burrows, it is called the Cicada-killer.

**10. Second** submarginal cell petiolate or triangular; marginal cell without appendix; middle tibiæ with two apical spurs; antennæ arising well above the clypeus....**11.**

**Second** submarginal cell broadly sessile, not triangular or petiolate.....**12.**

**11. Metathorax** with the upper hind angles acute or produced as short spines; 3, rarely 2, submarginal cells. NYSSONIDÆ. Nest in sand; *Nysson* our only genus.

**Metathorax** with the hind angles rounded or obtuse. ALYSONIDÆ. *Alyson* our only genus.

**12. Marginal** cell usually with an appendix; antennæ arising close to the clypeus; middle tibiæ with 1 or 2 apical spurs; hind ocelli frequently aborted..LARRIDÆ (p. 436).

**Marginal** cell without appendix; antennæ arising far above the clypeus; middle tibiæ with 2 spurs; ocelli normal. GORYTIDÆ. *Gorytes*, variously divided, is our only genus. Its species nest in sand and provision with Homoptera, especially Cercopidæ.

### Psenidæ

1. **Three** complete submarginal cells. Pseninæ. Our principal genus is *Psen*. They nest either in sand or in twigs and provision their nests with Homoptera.

**Two** complete submarginal cells. Pemphredoninæ. . 2.

2. **Eyes** large, their inner margins converging above. *Plenoculus*. Nests in sand.

**Eyes** small, inner margins not converging above; head well developed behind the eyes. . . . . 3.

3. **Only** 1 recurrent vein in front wings. . . . . 4.

**Two** recurrent veins. . . . . 5.

4. **Abdomen** with a distinct petiole. *Stigmus*. Our species, *americanus*, provisions its nests, in branches or stumps, with aphids.

**Abdomen** without a petiole. *Spilomena;* our principal species is *pusilla*.

5. **Abdomen** with a petiole; head and thorax rather hairy. *Pemphredon*. As far as known, the species prefer to make their nests in decaying wood, provisioning with aphids.

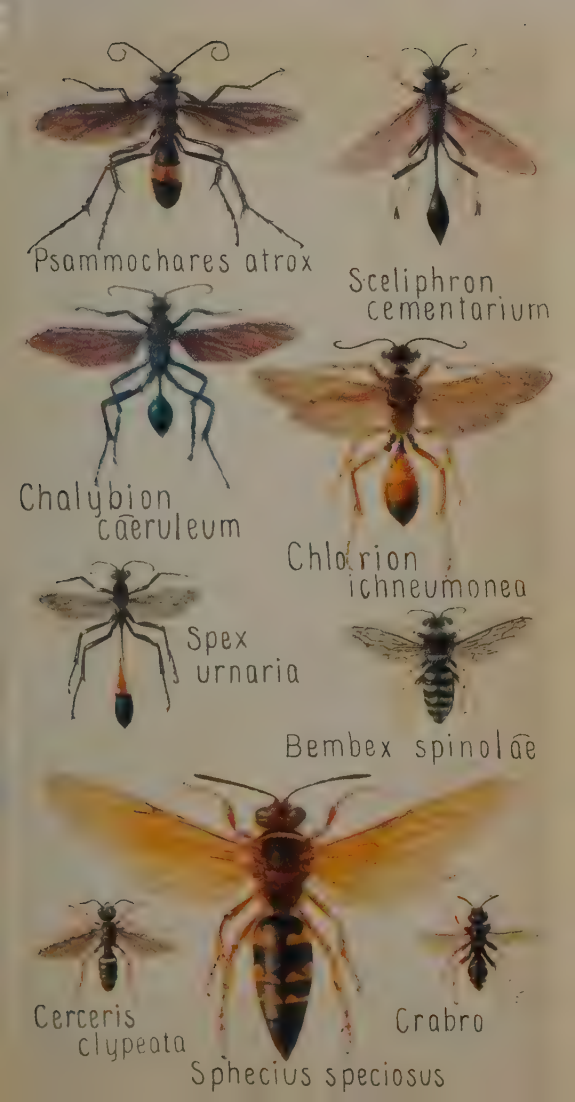
**Abdomen** without a petiole; head and thorax not hairy. *Passalocæus*. They nest in rotten wood, galleries of wood-boring insects, and hollow plant-stems, provisioning with aphids and other small insects.

### Oxybelidæ

In *Notoglossa emarginata* the process on the back of the thorax is broad and slightly forked at the tip. Our other species belong to *Oxybelus*, the process being acute at the tip. European observations indicate that they nest in sand, provisioning with small flies, which they crush with their mandibles but carry home on their sting.

### Crabronidæ

These wasps are usually much less than half an inch long and black, often marked with yellow. The head is large and rather square-cut. *Anacrabro* has the abdomen depressed, flat beneath; the second discoidal cell is much


Psammochares atrox
Sceliphron cementarium
Chalybion caeruleum
Chlorion ichneumonea
Spex urnaria
Bembex spinolae
Cerceris clypeata
Crabro
Sphecius speciosus

longer than the first and pointed at the tip. Our only species, *ocellatus*, nests in sand banks and provisions with bugs of the genus *Lygus*. Our other genus is *Crabro* (Plate XCII), which is much split up in the recent classifications, but some of the distinctions are rather technical. Different groups of species have different habits; nesting in wood, stems, and soil; provisioning with mites, spiders, flies, bugs, aphids, and moths.

### PHILANTHIDÆ

In the Hymenoptera of Connecticut they have widely separated *Cerceris* from *Philanthus* because the latter has a suture on the sides of the thorax, below the front wings, which the former lacks. For our purpose the four genera accepted years ago seem sufficient.

1. **Third** submarginal cell very large, somewhat quadrate, scarcely narrowed towards the marginal cell and extending beyond it; first abdominal segment narrowed. *Eucerceris*. For the most part, western.

**Third** submarginal cell much narrowed towards the marginal, leaving a broad deep sinus between them, the former not extending beyond the latter. . . . . 2.

2. **Basal** segment of abdomen narrower than the second, all the segments more or less constricted; second submarginal cell petiolate; marginal cell rather obtuse at apex and rarely extending beyond the third submarginal cell. *Cerceris* (Plate XCII).

**Basal** segment of abdomen nearly or quite as broad at apex as the base of second segment, segments rarely constricted; second submarginal cell not petiolate; marginal cell usually narrowed, pointed at apex, and extending beyond the third submarginal cell. . . . . 3.

3. **Inner** margins of eyes indented; antennæ arising from the middle of the face not far above the clypeus, not near each other; apex of marginal cell touching the front margin. . . . . *Philanthus*.

**Margins** of eyes not indented; antennæ arising from above the middle of the face, near each other or the clypeus; apex of marginal cell not touching the front margin. . . . . *Aphilanthops*.

The Peckhams, in their account of Solitary Wasps, have called the members of this family Grave Diggers. The name was probably not intended to be distinctive; its appropriateness depends upon the viewpoint for, as is the case with other families, the grave of the victims is the nursery of the wasps. *Cerceris* stocks up with beetles, especially weevils; while *Philanthus* uses bees, especially *Halictus;* and *Aphilanthops*, queen-ants.

### Trypoxylonidæ

Our only genus is *Trypoxylon.* The abdomen is narrow and longer than the head and thorax. The species are either all black, or marked with red. They were formerly accused of being parasitic because they had been reared from nests made by other wasps. Then the charge was changed to laziness, but I contend that they do well to use perfectly good mud-daubers' nests, and the like, which are no longer used by the original owners. Small species use the hollows of cut straws and wood-boring beetles' burrows. Chinks in masonry are also used. If the chinks are too large, they may be made smaller by plastering them with mud, and the partitions between the cells, each containing an egg and sufficient food for one larva, are made of mud. The nests are usually provisioned with spiders. The male of *Trypoxylon rubrocinctum* is exceptional among Hymenoptera in the interest he takes in household affairs. He stands guard at the nest while the female is out hunting food.

### Larridæ

These wasps usually nest in the ground. While fairly numerous, they are not very showy. The Larrinæ usually take Orthoptera for larval food; and the Astatinæ, Homoptera.

1. **Metasternum** with a large process which is deeply indented ventrally; middle tibiæ with one apical spur; marginal cell with an appendage. Larrinæ.....2.

**Metasternum** without a large, deeply indented process; middle tibiæ with two apical spurs; marginal cell

truncate; back of abdomen flattened. Astatinæ. For the most part, they are less than .5 in. long. *Astata unicolor* (abdomen black) and *bicolor* (abdomen red) are common species.

2. **Hind** ocelli perfect; inner margins of eyes nearly parallel; pronotum trilobed. *Lyroda triloba* (wings dark all over) and *subita* (wings dark at tips). Larval food, *Nemobius*.

**Hind** ocelli imperfect, flattened; inner margins of eyes converging above; pronotum simple.....3.

3. **Front** of head strongly raised so that there is a transverse ridge below front ocellus; mandibles toothed (in *Larra* there are no teeth); hind ocelli narrow; tip of abdomen with silver pile. *Notogonidea argentata;* larval food, immature crickets.

**Front** not strongly raised.....4.

4. **Hind** ("side") ocelli oval or elongate-oval in outline; front not raised along inner margins of eyes; tip of abdomen without pile. *Tachysphex.* There are a number of species of these sand-loving wasps.

**Hind** ocelli larger dorsally so that they appear hooked.....5.

5. **Front** slightly raised along inner margins of eyes; pygidium without pile. *Larropsis distincta.*

**Front** not raised along inner margins of eyes; pygidium clothed with pile. *Tachytes* of which we have numerous species, all probably nesting in sand and stocking their nests with grasshoppers.

### Bembecidæ

All of this family nest in the ground. *Bicyrtes* seems to prefer Hemiptera as larval food and, after stocking the nest, seals it up. The other species, mentioned here, use flies and, unlike most solitary wasps, feed their larvæ from day to day. Sometimes a large number of individuals nest close to each other.

1. **Mandibles** simple. *Microbembex, monodonta* being the specific name usually given to all from the Northeast; black with greenish-white markings.

**Mandibles** having a tooth within.....2.

2. **Propodeum** (apparently the hind part of the thorax) indented behind. *Bicyrtes* (=*Bembidula*) *quadrifasciata* (length about .75 in.; metanotum black; abdominal spots much wider at the sides), and *ventralis* (about .5 in.; metanotum with yellow spots; abdominal spots but little, if any, wider at the sides).

**Propodeum** not indented behind, straight or convex.....3.

3. **Front** ocellus round or kidney-shaped. *Stictia carolina* is an inch long and marked with black and yellow.

**Front** ocellus narrow. *Bembex*, of which *spinolæ* (Plate XCII) is our common species.

### Sphecidæ

These are the Thread-waisted Wasps. There have been a number of unfortunate, but necessary, changes of scientific names. Most confusing of these is the use of *Sphex* for what had been called *Ammophila*. I fear the end is not yet.

*Chlorion* is distinguished from the rest of the family by the second and third submarginal cells each receiving a recurrent vein; in the others, the second receives both. The females make burrows in the ground for nurseries. The following subgenera (or genera) occur in the Northeast and elsewhere.

1. **Second** submarginal cell wider than long.....2.

**This** cell longer than wide.....3.

2. **Tarsal** claws with one inner tooth. *Chlorion*, in a restricted sense. Provisions its nests with crickets. Our common bronze- or purplish-blue species is *cyaneum*.

**Claws** with 3 to 6 teeth. *Priononyx;* abdomen of *bifoveolatum* is reddish or yellowish, that of *atratum* is dark brown or black. The latter, at least, provisions with grasshoppers.

3. **Petiole** of abdomen more than twice the length of the hind coxæ; marginal cell not extending beyond the third submarginal cell.....*Isodontia*.

**Petiole** of abdomen as long, or only a little longer than, hind coxæ; marginal cell extending beyond the third

submarginal cell. *Ammobia* (formerly called *Sphex*); *pennsylvanicum* has black abdomen and legs; for *ichneumoneum*, see Plate XCII. The nests are stocked with grasshoppers.

In *Sphex* (in a limited sense) the petiole is composed of the entire first and part of the second abdominal segment. Species of this genus stock their underground nest with paralyzed caterpillars. *S. abbreviata* (abdomen black) and *procera* (abdomen partly red) usually have complete, transverse striæ on the back between the wings. Plate XCII shows *urnaria*. *Psammophila* is considered by some to be a subgenus of *Sphex*, and, like it, has a U-shaped dorsal area at the hind end of the thorax, but the petiole is not especially long and is one-jointed, the second abdominal segment being bell-shaped.

*Chalybion* and *Sceliphron* have a U-shaped area on top of the thorax at the hind end. See Plates XCI and XCII; both species provision their clay nests with spiders. The markings of *S. cementarius*, the Mud-dauber, vary considerably; its flat nests are to be found on the rafters of nearly every garret.

## APOIDEA

Although wasps visit flowers, they usually do so in their individual interest: to secure food for themselves and not to provide for their offspring. Bees, on the other hand, not only eat pollen and nectar themselves but, except for the "cuckoos" which lay their eggs in other bees' nests, store their nests with honey (modified nectar) and pollen. Although they thus take, in the aggregate, large quantities of pollen, they are of great benefit to the plants because they, incidentally and unconsciously, transfer this substance from one flower to another, thus fertilizing the ovum, which develops into a seed. Male bees have 13-jointed antennæ and 7 visible, abdominal segments; females, one less of each. Only the Bombidæ and Apidæ have developed a "worker caste." In other families, the mother does the work of provisioning the nest, carrying

home pollen on her hind legs, on the hairs of her abdomen (e. g. *Megachile*), and in other ways, and regurgitating, as honey, the nectar she swallowed.

In general, the PANURGIDÆ, PROSOPIDÆ, STELIDIDÆ, MEGACHILIDÆ, and a few NOMADIDÆ have but 2 submarginal cells, and the remainder have 3, but this rule is not without exceptions. As a rule, the females and most males of HALICTIDÆ to ANTHOPHORIDÆ (p. 444), inclusive, have a flat, triangular area on the last dorsal, abdominal segment, the other families lacking it. In the Honey-bee (p. 453) the marginal cell is very long and the posterior tibiæ have no apical spurs. These and the following notes apply principally to Atlantic Coast species.

### HALICTIDÆ

For the most part small bees; the first discoidal cell is not as long or scarcely longer than the marginal cell which is not square-cut at the tip; basal vein rounded posteriorly, first recurrent vein not meeting the first transverse cubital; second recurrent not sinuate; first submarginal cell conspicuously longer than the third and often as long as the second and third combined; stigma well developed, lanceolate; hind basitarsi narrower than tibiæ. The labrum is not free from the mandibles and not as large as the clypeus, which is hardly protuberant; tongue, acute, flat; no pubescent depressions in the face. See also Andrenidæ.

There are two main divisions which may be classed as genera: *Sphecodes* (abdomen smooth, shining, naked, the chitin usually red and black, fifth segment of female's without a furrow) and *Halictus* (abdomen usually not shiny, segments 1 to 4 or 5 usually fringed at apex with pale pubescence, fifth of female's with a median longitudinal furrow). *Augochlora* (body entirely metallic blue or green; first recurrent vein usually ending at or near the apex of the second submarginal cell) and *Agapostemon* (males have only the head and thorax metallic colored; first recurrent vein received by the second submarginal cell near the middle; Plate XCIV) may be classed as subgenera of *Halictus*, although other systems are used by good authorities.

*Sphecodes*, the Wasp-bees (so-called from their resemblance to small wasps, Plate XCIII), have had champions who opposed the charge that they lay their eggs in nests prepared by others, their young devouring the food and doubtless the young of their hosts, but there is strong evidence that they are supported by their relatives, *Halictus*, and possibly by other bees. The other Halictidæ usually nest in the ground, frequently making branched tunnels, many individuals selecting the same restricted area for their burrows. Some species of *Halictus*, in the limited sense, are very small and are called Sweat-bees because they seem fond of alighting on perspiring humanity. Some of the species are among the first bees to appear in the spring. The pupæ are enclosed in transparent, skin-like cocoons.

### Andrenidæ

These are usually black (with pale pubescence), medium-sized bees. They are closely related to the Halictidæ but the basal vein is almost, or quite, straight, and the face, at least of females, has pubescent depressions. In *Melitta* (apical joint of antennæ obliquely truncate; ocelli placed in a curve) and *Andrena* (that joint not obliquely truncate; ocelli placed in a triangle) the first submarginal cell is conspicuously longer than the third but in the southern *Nomia* it is about the same length. Our only species of *Melitta* is *americana*.

*Andrena* (Plate XCIII), our principal genus, is extremely well supplied with species. They all seem to nest in the ground but the sites chosen for their burrows vary greatly. Some species make simple tunnels, others branched, but none seem to do much more than smooth the sides and stock each tunnel or branch with a pill of pollen and an egg, filling the opening, of course, with loose dirt. At least some of the species have two generations a year, and it is not unlikely that, in some cases, what we now call distinct species are merely the alternate generations of one.

### Panurgidæ

The marginal cell is sharply truncate at the tip and the lower corner has an appendicular vein except in *Halictoides*. This genus is often put in a separate family, Dufouridæ. It differs from the other genera in also having the labrum free from the mandibles and as large as the clypeus. With the exception of *Protandrena*, there are only two submarginal veins. The stigma is large. The chitin often has yellow markings; the clypeus is hardly protuberant; and the tongue is acute and flat. *Macropis* (often put in a separate family, Macropidæ) has the hind basitarsi as broad as the tibiæ. In *Perdita* (Plate XCIII) the marginal cell is not longer than the stigma; they are small bees with the head and thorax usually metallic dark green or blue, and the abdomen usually with light, chitinous markings. In *Calliopsis* (hairy bees, with hairy bands on the abdomen) and *Panurginus* (abdomen shiny black, unbanded) the marginal cell is relatively longer; the head and thorax are not metallic.

### Nomadidæ

These bees are usually less than half an inch long; some are almost hairless, with yellow or red, chitinous markings. They are rather wasp-like in appearance and all are "cuckoos," lacking pollen-collecting apparatus and living in the nests of other bees. There are usually three submarginal cells; the first recurrent vein does not meet the first transverse cubital; the first discoidal cell is much longer than the marginal, which is rarely longer than the first two submarginal cells united and not truncate; first portion of subdiscoidal vein shorter than the third portion of the discoidal; clypeus protuberant; labrum large, free, convex; tongue elongate, slender; eyes extending to, or nearly to, the base of the mandibles. In *Nomada* (Plate XCIV) the apex of the marginal cell touches the front wing-margin and the abdomen has chitinous bands or spots. In *Epeolus* (maxillary palpi 2-jointed) and *Triepeolus* (maxillary palpi 3-jointed; Plate XCIII) the apex of the marginal cell is obtuse and does not touch the

Apis mellifera

Xenoglossa pruinosa

Emphor bombiformis

Ceratina dupla

Osmia lignaria

Megachile brevis

Dianthidium notatum

Coelioxys dubitata

Perdita 8-maculata

Sphecodes arvensis

Triepeolus donatus

Colletes compactus

Andrena vicina

Prosopis zizia

wing-margin; abdomen black with pale bands of scale-like hair. *Neopasites* has two submarginal cells; marginal cell very obtuse; maxillary palpi 6-jointed.

### Anthophoridæ

These are moderately large, hairy, pollen-collecting bees. The clypeus is protuberant and, in males, usually yellow. The males often have long antennæ. The tongue is elongate and slender; the labrum large, free, and convex; eyes extending to, or nearly to, the base of the mandibles; marginal cell rarely longer than the first two submarginal cells united; first recurrent vein not meeting the first transverse cubital; first portion of the subdiscoidal vein distinctly longer than the third portion of the discoidal; stigma not well developed. There are usually 3 submarginal cells.

In *Anthophora* (Anthophoridæ in a limited sense) the marginal cell is not bent away from the front wing-margins; first discoidal cell longer than the marginal cell; third submarginal cell not narrower above than beneath. In our other bees of this group the first discoidal cell is not as long as, or scarcely longer than, the marginal cell, which is bent away from the front.

In *Melitoma* (pads between the tarsal claws; tongue reaching the base of the abdomen; first and third submarginal cells of about equal length) and *Emphor* (no such pads; first submarginal cells longer than the third, which is narrowed towards the marginal) the vertex is not crested; the males' antennæ are only slightly, or not at all, longer than the female's and the clypeus is not pale. Of *Melitoma* we have only *taurea* (abdomen cross-banded with white), and of *Emphor* only *bombiformis* (Plate XCIII) or, in the North, its variety *fuscojubatus* (thorax evenly covered with pale hairs; abdomen black except, sometimes, for scattered, pale pubescence on the first segment). These genera have been put in a separate family, Emphoridæ.

Most of the Eastern Anthophorids have been separated off as Euceridæ. They differ from the Emphoridæ in having the vertex raised. The male's clypeus is more or

less yellowish and his antennæ are noticeably longer than the females. In *Tetralonia* (maxillary palpi 6-jointed), *Xenoglossa* (max. palpi 5-jointed; tarsal claws cleft), and *Cemolobus* (max. palpi 5-jointed; claws toothed but not cleft) the lower anterior portion of the orbits have a large, somewhat triangular, space; the clypeus is remote from the eyes. *T. atriventris*, *X. pruinosa* (the name referring to the frosted bands on the abdomen; Plate XCIII), and *C. ipomœæ* are the Northeastern species. In *Melissodes* the orbital-malar space is small; clypeus nearly touching the eyes; maxillary palpi usually 4-jointed. There are numerous species.

The habits of all Anthophoridæ are much alike: burrows are made in the ground and stocked with a paste of pollen and honey for larval food.

### Prosopidæ

These small bees, black with yellow chitinous markings, have two submarginal cells, the second of which is squarish, slightly if any longer than high, and conspicuously shorter than the first; the first recurrent vein often meets the first transverse cubital; the marginal cell is elongate and not square-cut at the tip; tongue flat and bilobed; face pitted. *Prosopis* (Plate XCIII) is our only genus. Perhaps we should use the names *Hylæus* and Hylæidæ. The Masked Bees have been accused of being lazy because they are even less hairy than such confirmed cuckoos as *Nomada*. However, their lack of hair may be correlated with the fact that, unlike other industrious bees, they do not carry pollen on the outside of their bodies. They first eat it and then, having reached their nest, regurgitate it, mixing it with honey, to prepare food for the babies they never live to see. They nest in raspberry stalks and the like.

### Colletidæ

The first recurrent nervure is received by the second of the three submarginal cells; first discoidal cell is not as long or scarcely longer than the marginal; stigma well

developed; second recurrent nervure strongly bent outward in its lower half; tongue flat and bilobed; face pitted. The name of our only genus, *Colletes* (Plate XCIII), means Plasterer. The species are black, with light hairs but no yellow, chitinous markings. They nest in holes, made in the ground or in loose masonry, and often a number of females nest close to each other. They plaster the sides of these holes, and the cells which they make in them, with a secretion that dries rapidly to form "a membrane more delicate than the thinnest goldbeater's skin, and more lustrous than the most beautiful satin."

### Megachilidæ

In a broad sense, this includes bees having two submarginal cells; tip of marginal pointed; second recurrent vein not bent or directed outwardly before joining the first portion of the subdiscoidal vein; face not pitted; tongue long, rather thread-like. The under side of the female abdomen has pollen-collecting hairs, except in the cuckoo genera. The second submarginal cell is much longer than high and almost equal, in length, to the first.

*Stelis* includes black bees with whitish margins on the dorsal, abdominal segments, and with cuckoo habits. The tarsal claws are cleft, having an inner tooth near the apex; male abdomen not toothed or lobed at the apex. *Cœlioxys* (Plate XCIII) is also a lazy genus. The abdomen is narrowed behind, and, in the males, armed with teeth or spines; scutellum usually toothed on the sides; tarsal claws simple or with a basal tooth; eyes with fine hairs. Both genera have been put in families of their own.

The industrious members of our Megachilidæ have the tarsal claws as described for *Cœlioxys*. In *Dianthidium* (pads between tarsal claws; Plate XCIII) and *Anthidium* (no such pads) the chitin of the abdomen bears pale markings and in the others it does not. The former makes nests of resin on rocks, etc.; the latter uses the down off of woolly-leaved plants for nests in burrows. *Heriades* (stigma lanceolate, well developed; head considerably extended behind the eyes) and *Andronicus* (stigma short, not well developed) are black bees with tarsal pads. *Osmia*

(Plate XCIII) includes metallic green, bluish, or purplish bees with tarsal pads. They are called Mason-bees because they construct small, earthen cells under stones, in burrows excavated in twigs and decaying wood, in deserted snail-shells, in plant-galls, and elsewhere. The last to be mentioned but richest in species is *Megachile* (Plate XCIII), moderately large bees without pads between the tarsal claws; stigma short, not well developed; tip of marginal cell obtuse and separated from the front wing-margins. The species of *Megachile* are called Leaf-cutters because the females snip more or less circular pieces out of leaves, especially of roses, and of petals. These pieces are fitted together and glued so skillfully that they form tight, thimble-shaped cells, snugly filling some suitable, ready-made space or burrows which the females make in wood or earth. Putnam estimated that the thirty cells, arranged in nine rows, under a board in his piazza roof contained at least a thousand pieces. Reed recorded nests made by one of our common species, *brevis*, in curled plum leaves.

### Ceratinidæ and Xylocopidæ

The Carpenter-bees make nests in wood or in stems of plants. There are three submarginal cells; the first discoidal cell is not as long as or scarcely longer than the marginal cell; apex of sixth dorsal, abdominal segment of females with a spine. *Ceratina* (Plate XCIII) includes small, dark blue-green bees with the first submarginal cell longer than the second and about as long as the third; stigma well developed, lanceolate. They dig out the pith of elder, raspberry, etc., so that they may have tunnels in which to nest. The large Carpenter-bees which make galleries in rather solid wood, such as porch-posts, are *Xylocopa* (*virginica*, Plate XCIV, is the only Northern species). The stigma is short and not well developed; first submarginal cell shorter than the second, third almost as long as the first and second combined. They are given to biting through the base of a flower instead of getting at the nectar in a more legitimate way.

### Bombidæ

The burly Bumble-bees are so conspicuous, abundant, and appealing, that I am giving them considerable space. The first discoidal cell is not as long or scarcely longer than the marginal, which is pointed at the tip and extends far beyond the apex of the third submarginal cell; the stigma is not well developed; second submarginal cell is rather longer than either the first or third, and strongly produced at the lower basal corner. *Psithyrus* is a lazy genus that lives with its relatives. There are no workers, the "queen" living in a *Bombus* nest and letting the *Bombus* workers bring up its young. *Bombus* is a social bee; that is, a family nest is made and the older daughters do not mate but give their attention to caring for the nest and feeding their younger brothers and sisters. The best book on their biology is by Sladen, *The Humble-bee, its life-history and how to domesticate it.* As might be guessed by the common name he uses, it is about English species, but then we know very little about our own.

The fertilized female ("queen") passes the winter in some snug retreat and early in spring starts her nest, it may be in a deserted field-mouse's burrow. After arranging dried grass and the like to form the nest, she collects pollen and makes a pile of it, moistened with honey, on the floor of the nest. She also makes a honey-pot of wax near the doorway and fills it with rather liquid honey. Eggs are laid on the pollen-mass, covered over with wax, and more or less incubated by the queen, especially during inclement weather. At such times she feeds out of the honey pot. When the larvæ hatch, they feed on the pollen mass under the waxen coverlet, which the mother pierces from time to time in order to give them special meals of honey and pollen, chewed up together. When the larvæ have attained full size (it takes ten days or two weeks), each spins a thin, papery, but tough, oval cocoon and pupates, the queen brooding on the cocoons and sipping from her honey-pot. In a week or two the first workers emerge and take up the household duties. Workers are females but smaller than queens; males and queens are not born until late in the season.

## KEY TO THE BUMBLE-BEES.

The following key is to the species of the Atlantic Coast of the United States. The more western and extremely variable *rufocinctus* is omitted. *P.* stands for *Psithyrus; B.* for *Bombus;* and *B.B.* for *Bombias*, a subgenus of *Bombus*. "Occiput" is the top of the head. "Pleura" refers to the side of the thorax especially in front, below the front wings. "Scutellum" is the triangular hind part of the top of the thorax. "Interalar band" is on the top of the thorax, between the wings. The "malar space" is between the eyes and the jaws. The "supra-orbital line" is an imaginary line from the top of one compound eye to the top of the other. The notes on color refer to the color of the hairs, not to the chitin; and the upper side of the abdomen is all that is considered when giving its color.

1. **Divisions** of tarsal claws very unequal; 12 antennal joints; 6 visible, abdominal segments (Females).....2.

**Divisions** of tarsal claws subequal; 13 antennal joints; 7 visible, abdominal segments (Males).....15.

*Females*

(The female of *P. tricolor* is unknown unless *fernaldæ* be it.)

2. **Outer** face of hind tibiæ convex and hairy. *Psithyrus.* 3.

**Outer** face of hind tibiæ concave and bare, except at margins. *Bombus*.....5.

3. **Occiput** black with little or no yellow; lower portion of pleura with dark hairs.....*P. ashtoni.*

**Occiput** with much yellow.....4.

4. **Thorax** without interalar, black hairs but disk bare; pleura light; little or no yellow on fourth abdominal segment; face largely dark.....*P. laboriosus.*

**Thorax** with interalar, black hairs; pleura mostly light; no reddish on fifth abdominal segment but yellow, at least on the sides, on the fourth.....*P. insularis.*

**Thorax** with or without interalar, black hairs; lower pleura yellow or dark; fourth abdominal segment almost entirely covered with yellow; often with reddish on sides of fifth; apical, abdominal segment very pointed and strongly recurved.....*P. fernaldæ.*

5. **No** distinct interalar, black band.....6.
**Black** interalar band.....9.

6. **First** to fourth abdominal segments largely yellow. *B. fervidus dorsalis.*
**Third** and fourth segments largely black.....7.

7. **Ocelli** large, the lateral ones farther from each other than from the margins of the eyes and below the supra-orbital line; occiput and face largely black; first abdominal segment yellow, the others black except for (usually) brownish at the middle of the base of the second..... *B. B. separatus.*
**Ocelli** small.....8.

8. **First** abdominal segment yellow, second and following segments without yellow; occiput largely yellow; face wide and largely black.....*B. impatiens* (Plate XCIV).
**First** abdominal segment yellow, some yellow at basal middle of the second, otherwise the abdomen black; occiput largely yellow; face long, triangular, black..... *B. bimaculatus.*
**First** abdominal segment largely yellow; the yellow which largely covers the second segment is notched in the middle behind and, in the workers, usually mixed with red; third to fifth black; frequently considerable interalar black; occiput largely black; face wide and black; pleura yellow.....*B. affinis.*
**First** and second segments largely yellow and remainder of abdomen largely black; disk of thorax not nude and without black; pleura usually black; occiput largely yellow; face largely black.....*B. perplexus.*
**First** and usually the second abdominal segments yellow, the remainder usually largely black; pleura yellow; disk nude and with scattered, black hairs; occiput largely yellow in queens and usually so in workers; face long and largely black.....*B. vagans.*

9. **Second** and third abdominal segments red, second and fourth largely yellow, the remainder black..... *B. ternarius* (Plate XCIV).
**Third** and following segments black, the first two largely yellow.....10.
**Third** segment yellow.....11.

10. **Ocelli** large, separated from each other, and below

Bombus
impatiens
ternarius
♀
♀
♂
pennsylvanicus
Xylocopa virginica
♂
♀
Nomada luteola
Agapostemon radiatus

the supra-orbital line; yellow on second segment neither notched nor mixed with red; face and occiput black.....
*B. B. fraternus.*

**Otherwise**, see *B. affinis* (8).

11. **First** to fourth segments yellow, the remainder largely black.....12.

**Fourth** segment black, also pleura and often the scutellum.....13.

12. **Pleura** black; face and occiput largely light.....
*B. borealis.*

**Pleura** largely yellow; face (largely) and occiput black.....*B. fervidus.*

13. **Ocelli** large, separated, and below the supraorbital line; first abdominal segment largely black, second largely yellow, third yellow, the remainder black; occiput either black or yellow; face black.....*B. B. auricomus.*

**Otherwise**.....14.

14. **Second** and third abdominal segments yellow, the remainder black except that there is often considerable yellow on the fifth and sixth; face (largely) and occiput black.....*B. terricola.*

**First** (largely), second, and third abdominal segments yellow, otherwise black; face and occiput black.....
*B. pennsylvanicus* (Plate XCIV).

*Males*

15. **Ocelli** large, the lateral ones not much, if any, more than their diameter from the margins of the eyes, and below the supraorbital line; eyes bulging.....16.

**Ocelli** otherwise.....18.

16. **First** (usually), second, and third abdominal segments yellow, the remainder largely black; sometimes interalar black; third antennal segment as long as the fourth and fifth combined.....*B. B. auricomus.*

**Otherwise** colored and third antennal segment at most not much longer than the fifth.....17.

17. **First** abdominal segment yellow, the remainder black except for brownish on basal middle of the second and, sometimes, yellow at sides of third; face largely yellow.
*B. B. separatus.*

**First** and second abdominal segments yellow, the remainder largely black; face largely black. . *B. B. fraternus.*

18. **Second** and third abdominal segments red; first (largely) and fourth yellow; fifth and sixth black; interalar black; pleura, face, and occiput, yellow. . . . . *B. ternarius.*

**Third** segment not red. . . . . 19.

19. **Sixth** and seventh abdominal segments largely red, the others variable; face largely black; occiput yellow. . *P. tricolor.*

**Sixth** segment not largely red. . . . . 20.

20. **First** and fourth abdominal segments black; second and third yellow; the remainder variable; interalar black; pleura black; face largely yellow. . . . . *B. terricola.*

**First** abdominal segment largely yellow. . . . . 21.

21. **First** to fourth, inclusive, abdominal segments largely yellow. . . . . 22.

**Not** so. . . . . 23 (and also *B. perplexus*, 22).

22. **First** abdominal segment usually with some black, fifth usually black; interalar, pleura usually, and scutellum sometimes, black; occiput black; .6 to 1 in. long. . . . . *B. pennsylvanicus* (Plate XCIV).

**No** black on first or fifth abdominal segments; interalar sometimes, and scutellum, yellow; interalar usually, and occiput black; .4 to .7 in. long. . . . . *B. fervidus.*

**No** black on the first but usually on the fifth abdominal segments; interalar and usually the pleura black; occiput and sometimes the pleura yellow. . . . *B. borealis.*

**No** black on the first abdominal segment, but the fourth and fifth usually black although the whole abdomen may be yellow; interalar, occiput, and usually the face and pleura, yellow; face triangular, not long (as in *fervidus* and *borealis*). . . . . *B. perplexus.*

23. **Second** abdominal segment with little or no black. . 24.

**This** segment with considerable black. . . . . 25.

24. **Occiput,** interalar, and pleura, largely yellow; face largely black; first abdominal segment, usually the second, and sometimes the third, yellow; abdomen otherwise black. . . . . *P. laboriosus.*

**Occiput** (usually largely) and face black; interalar often with much black; pleura, and most of the first abdominal segment, yellow; yellow of the second segment

usually mixed with red and notched behind; remainder of the abdomen without yellow.....*B. affinis.*

**Occiput**, pleura, and face (largely) yellow; very little, if any, interalar black; first two abdominal segments yellow, the remainder usually black.....*B. vagans.*

**25. Face**, occiput (usually), and pleura black; first (usually) and fourth abdominal segments yellow, the remainder largely black.....*P. ashtoni.*

**Face** (largely), occiput, and pleura, yellow; first and part of the second abdominal segments yellow, the remainder black.....*B. bimaculatus.*

**Face** (usually), occiput (largely), pleura, and first abdominal segment yellow; remainder of abdomen black. *B. impatiens.*

### APIDÆ

Although the American tropics have several genera of Stingless Honey-bees, our only species of this family is the introduced and cultivated Honey-bee or Hive-bee, *Apis mellifera* (see p. 440). The color of the abdomen is variable. It is probably the most written-about insect. Maeterlinck's *Life of the Bee* is a classic. *Beekeeping* by Phillips and *How to Keep Bees* by Mrs. Comstock are both excellent. The individuals usually seen are workers, almost sexless females. As in other bees, and many other insects as well, the legs are not concerned solely with walking. Plate XCIII shows the device (*a*) on the front legs for cleaning antennæ, and a part of the pollen-gathering apparatus on the hind legs. The basitarsus (*b*) has pollen combs on the inner side which scrape the pollen from the abdomen and the second pair of legs. This pollen is a sticky mass because of honey added from the bee's mouth. It is removed from these pollen combs by a row of stiff hairs at the end of the tibia and then is pushed upward into the corbicula (*c*), or pollen basket, by means of the projection, which is just below the tibial combs, shown at the base of the basitarsus. The long hairs on each side of the corbicula prevent the load from slipping sideways. The notch between the tibia and tarsus has been called the wax-shears, but it has nothing to do with the manipulation of wax.

The swarming of the honey-bee brings about an increase in the number of colonies but it is the queen of the old colony, and not one of her daughters, which goes out to form the new colony. The stimulus to the act of swarming is not understood; since a swarm sometimes starts without a queen, she can not be the instigator. In fact, if she is detained by a trap or in some other way, the bees may destroy her and swarm with a virgin queen.

The swarming bees usually cluster on a branch or some other support before going to a cavity, such as a hollow tree, in which to start the new colony. The old-fashioned idea that ringing bells or beating tin pans will hasten this clustering is a mistaken one. If there be a delay in finding a suitable cavity, unprotected comb will be made on the branch where the bees have clustered.

Shortly after the swarm has departed, a young queen which has been left behind in her sealed-up cradle eats her way out, takes her mating flight several days later, and settles down to her work at the old stand with the help of such of her unmarriageable sisters as have remained.

## Notes on some of the GALLS MADE ON PLANTS BY INSECTS AND THEIR RELATIVES

Plant Galls are interesting to the zoölogist because most of them are made by animals; to the botanist because of the unsolved problems of abnormal plant growth they present; and to all of us, not only because ornamental and useful plants are frequently damaged thereby, but also because much of our food is dependent upon them. Potatoes are fungus root-galls, and the bacterial root-galls of legumes are Nature's principal agents in making atmospheric nitrogen available for plant use. Of the galls caused by insects, the only ones of commercial benefit are the oak galls, which have been used in dyeing, tanning, and the manufacture of ink.

As is the case with so many things in natural history, we must go back to Pliny for the first ideas concerning plant galls. This philosopher knew that a fly was produced in them, but he did not associate this fly with the cause of the gall growth. He thought that galls sprang up in a night and that the fly larvæ merely devoured this growth. However, the interest of the early observers was not always entirely biological. Important prophecies were deduced as to the events of the coming year by observing whether galls contained spiders, worms, or flies.

The constant occurrence of certain larvæ within certain galls at length aroused the suspicion that galls were formed by the larvæ. To account for the presence of the egg and larvæ, it was supposed that the female insect laid the egg in the ground and thence it was drawn up with the sap and carried to the outer parts of the plant, where it lodged and gall formation ensued. This theory soon met with opposition. Redi, a poet and physician of the seventeenth century, not having seen the eggs laid, assumed that the plant had a "vegetable soul" which produced galls with their eggs, larvæ, etc., while at the same time, it gave birth to flowers, fruits, and seeds.

Sprengel, 1793, is credited with having been the first to point out cross-fertilization in plants, but this is a mistake. Thirty years before, Filippo Arena, an Italian, wrote rather fully on the subject and, noting the cross-pollination by insects, stated that galls were developed by the plants for the express purpose of having insects ready at hand for the sake of pollination.

Malpighi, late in the seventeenth century, was the first to record the fact that the production of galls followed the puncture of vegetable tissues by insects, and he came to the conclusion that the insects inject a substance into the plant tissue which produces a swelling similar to that which the sting of a bee causes in animal tissue. Malpighi seems to have been correct. At least, we have, as yet, no better explanation of the origin of galls.

The number of different galls caused by animal parasites runs into thousands. Almost no form of plant life is exempt. Although certain of the higher plants, such as the oak, willow, rose, and goldenrod, are preëminently the gall-bearing plants, still algæ, fungi, ferns, and gymnosperms come in for their share.

Many of the galls of woody plants have been omitted here, but those of herbaceous plants, including grasses, have been, necessarily, almost ignored. The most consistent work with these, chiefly Itonididæ, has been done by Dr. E. P. Felt, State Entomologist of New York, to whose papers the student must be referred. The one in the *Ottawa Naturalist*, Vol. XXV., will be very helpful.

The notes and illustrations given here are arranged according to the plants on which the galls occur and with but little reference to the relationships of the makers. The illustrations are, for the most part, about half-size. The following list of genera will help to make the relationships clear.

MITES: *Acarus, Eriophyes, Phyllocoptes.*

HOMOPTERA; APHIDIDÆ: *Chermes, Colopha, Hamamelistes, Hormaphis, Pachypsylla, Pemphigus, Phylloxera.*

LEPIDOPTERA; TORTRICIDÆ: *Eucosma.*
GELECHIIDÆ: *Gnorimoschema.*

DIPTERA; MYCETOPHILIDÆ: *Sciara.*
ITONIDIDÆ, formerly called Cecidomyiidæ: *Asteromyia, Caryomyia, Cecidomyia, Cincticornia, Contarinia, Dasyneura, Hormomyia, Itonida, Lasioptera, Oligotrophus, Retinodiplosis, Rhabdophaga, Rhopalomyia, Schizomyia, Thecodiplosis.*
TRYPETIDÆ: *Eurosta, Œdaspis.*
AGROMYZIDÆ: *Agromyza.*

HYMENOPTERA; SAW-FLIES: *Euura, Pontania.*
CYNIPIDÆ: *Acraspis, Amphibolips, Andricus, Aulax, Biorhiza, Callirhytis, Cynips, Diastrophus, Disholcaspis, Dryophanta, Gonaspis, Holcaspis, Neuroterus, Rhodites, Solenozopheria.*

If the galls are inhabited, a clue to the makers may be gained by a study of the inhabitants. Mites have four pairs of legs, at least when full grown; no wings; and are very small. Aphids have three pairs of legs and they sometimes have wings. Galls made by both of these groups are usually open. Saw-flies have thoracic, and usually distinct abdominal, legs; their galls usually have a large hollow on the inside. Gall-making Lepidopterous larvæ have thoracic but no abdominal legs. It is not so easy to distinguish Hymenopterous and Dipterous larvæ; and it should always be remembered that galls may be inhabited by creatures which did not make them—parasites of the maker and also inquilines, "guests" which avail themselves of the abundant food but do not directly injure the maker of the gall. Some galls are complicated communities. We speak of creatures "making" the galls; the plants really do this, acting on some (not understood) stimulus furnished by the animals. It is exceedingly curious that insects which are so similar that they may be distinguished only with difficulty cause such different and distinctive galls. In addition to the unknown chemics of the process, the gall-causing instinct is one of the most mysterious things in entomology.

**Conifers**

The orange-colored larva of *Cecidomyia pini-rigidæ* lives in a basal enlargement of shortened, deformed needles of pitch pine; and *C. balsamicola*, of balsam. *Thecodiplosis ananassi* makes a brown, pineapple-like gall on cypress. *Itonida anthici* makes a whitish, flower-shaped, fungus-like growth on cypress. *Retinodiplosis resinicola* larvæ are orange "grubs" living in clear or whitish masses of pitch on the under side of pitch-pine branches; *R. inopis*, in resinous masses on scrub-pine leaves.

**Poplar and Cottonwood**

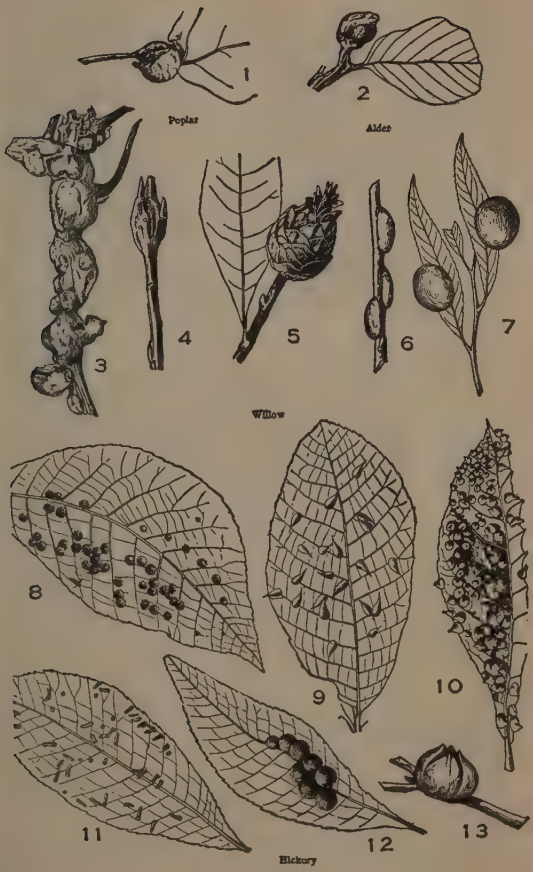
*Pemphigus populicaulis* makes globular galls at the base of leaves (Plate XCV, Fig. 1); *P. populi-transversus*, oval, somewhat elongated galls on the petioles; *P. populi-venæ*, yellow galls on midrib of leaf; *P. vagabundus* folds and crinkles the foliage. *Agromyza aeniventris* causes irregular, somewhat globular enlargements of young twigs.

**Willow**

More than fifty different galls have been described. See Plate XCV.

*Twigs*

*Phytophaga* (also put in *Rhabdophaga*) *rigidæ* (Fig. 4); *Rhabdophaga batatas* (Fig. 3) and *strobiloides* (Fig. 5). *R. strobiliscus* is like *strobiloides* but all the leaves are pointed at the tip. *R. rhodoides* and others make more open growths, resembling small, double flowers. *R. brassicoides:* bunches of oval, single-celled, sessile galls, each three-fourths to two and a fourth inches, "like the sprouts of a cabbage stump," usually not near tips of branches. *R. triticoides:* many-celled and resemble a wheat-head. *R. nodulus:* like *batatas* but smaller, more solitary, and only single-celled. For *Euura ovum* see Fig. 6; *E. nodus*, a smooth twig enlargement, one-fourth to twice normal diameter; *E. orbitalis*, enlarged, bud-gall.


1
2
Poplar
Alder
3
4
5
6
7
Willow
8
9
10
11
12
13
Hickory

*Leaves*

*Hormomyia verruca:* about .1 inch in diameter, on veins; about evenly divided by the leaf, the upper side flattish or with a minute nipple, the lower side wart-like. For *Pontania pomum* see Fig. 7, on midrib. *P. pisum:* pea-like, yellowish, on under side of leaves. *P. desmodioides:* smooth, flattish, sessile, yellowish-green, about equally divided by the leaf. *P. hyalina:* fleshy, reddish, in parallel rows on either side of the midrib. *P. borealis:* solitary, smooth, reddish, pear-shaped, about one-third above the leaf. *P. consors:* gregarious, hairy, rather spherical, near leaf-base, about one-third above the leaf. *P. gracilis:* spherical, smooth, near petiole to one side of midrib, about equally divided by leaf. *P. terminalis:* green swelling on upper surface; the leaf eventually rolls.

**Hickory**

Plate XCV. The principal twig-gall is *Phylloxera caryæcaulis* (Fig. 13). Numerous other species of *Phylloxera* make galls on the leaves. Of these the petiole bears *caryæren*, kidney-shaped; *subelliptica*, elongate, nut-like; and *spinosa*, irregular, spiny galls. On the leaves, those of *caryæyenæ* are keel-like pleats along the leaf-veins; *caryæfallax* crowded, conical, on upper surface; *deplanata*, reddish- or greenish-yellow, conical below; *depressa*, depressed, fringed; *pilosula*, hairy, light green, flattened above, below convex and with a nipple. The galls of *Caryomyia holotricha* (Fig. 8) are pubescent; *caryæcola* (Fig. 9), smooth; *sanguinolenta* (Fig. 10), red; *tubicola* (Fig. 11); and *persicoides* (Fig. 12), brownish, downy. *C. cynipsea* makes a round, hard, midrib gall, about half an inch across. *C. nucicola* deforms the husks.

**Alder**

*Dasyneura serrulatæ* causes deformations, with whitish "bloom," of terminal buds (Plate XCV, Fig. 2).

1
2
3
4
5
6
7
8
9
10
11
Oak

**Oak**

More than three hundred different galls have been listed.

*Leaves*

Plate XCVI shows *Amphibolips confluentus* (Fig. 1), spongy inside; *A. inanis* (Fig. 2), merely larval cell and radiating threads inside; *A. ilicifoliæ* (Fig. 3); *A. coelebs* (Fig. 5); *Callirhytis futilis* (Fig. 4), somewhat flattened, projecting on both sides of the leaf, inside are kernels kept in position by white filaments; *C. papillatus* (Fig. 7), somewhat nipple-shaped, projects on both sides, surrounded by a reddish areola; *C. capsulus* (Fig. 9); *C. palustris* (Fig. 11), hollow inside except for a loose kernel; *Andricus singularis* (Fig. 6), something like a small *inanis; Andricus flocci*, also called *lana* (Fig. 8), like a mass of wool with brown kernels; *Andricus petiolicola* (Fig. 10), many celled.

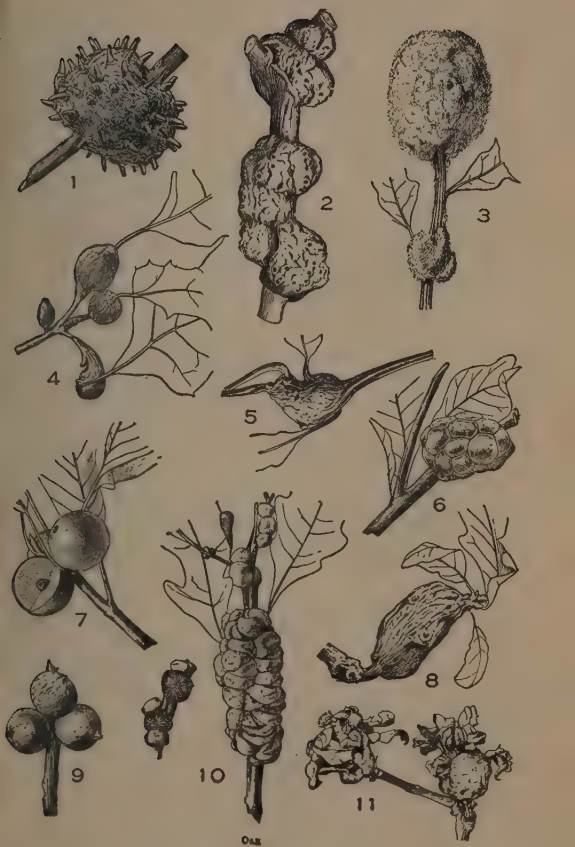
On Plate XCVII: *Andricus piger* (Fig. 1), under side of midrib; *Cynips prinoides* (Fig. 2), shiny, single-celled, under side of leaf; *Cynips pisum* (Fig. 3), surface finely netted, two cavities; *Acraspis erinacei* (Fig. 4), spines red when young; *Dryophanta polita* (Fig. 5), sometimes grows singly; *Neuroterus floccosus* (Fig. 6), with white hairs, under side of leaf; *N. umbilicatus* (Fig. 7), small nipple in deep, central depression, under side of leaf; *Cincticornia pilulæ* (Fig. 8), upper side of leaf; *Cecidomyia poculum* (Fig. 9), pale red to light lavender, under side of leaf; *Cecidomyia niveipila* (Fig. 12), fold lined with white pubescence. *Cynips decidua* makes galls about the size of wheat-grains on the under side of midrib, often 30 on a leaf.

Oak

*Twigs and other parts*

Plate XCVII, Fig. 10, shows the white, shot-like catkin gall of *Andricus pulchra* and, Fig. 11, the acorn gall of *Amphibolips prunus*.

Plate XCVIII shows *Callirhytis cornigerus* (Fig. 1); *C. punctatus* (Fig. 2) resembles *cornigerus* but without "horns"; *C. seminator* (Fig. 3), white or pinkish, woolly; *C. similis* (Fig. 4), usually on scrub-oak; *C. clavula* (Fig. 5), usually on white oak; *Cynips strobilana* (Fig. 6), hard and corky, with a single cell in each division; *Disholcaspis globulus* (Fig. 7); *D. duricaria* (Fig. 9), with sharp point at apex; *Biorhiza forticornis* (Fig. 10), pale yellow with reddish tinge when fresh, kernel of each division held by radiating fibers; *Neuroterus batatus* (Fig. 8), pale bluish bloom, corky, many larval cells; *N. noxiosus* (Fig. 11), hard, woody, many larval cells.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**Elm**

Plate XCIX, Fig. 1, shows galls of *Colopha ulmicola*. *Pemphigus ulmifusus* makes solitary, spindle-shaped galls on the upper surface of red elm leaves.

**Hackberry**

Plate XCIX shows *Pachypsylla cucurbitæ* (Fig. 4) on under side of leaf, concave in the middle, with a small nipple; *P. vesiculum* (Fig. 5), flat, blister-like, convex with a small nipple; *P. mamma* (Fig. 6), nearly cylindrical, apex rounded bluntly; *P. gemma* (Fig. 7), variable in shape and size, woody, numerous cells; *P. venusta* (Fig. 8), on petioles, several compartments.

**Witch-hazel**

Plate XCIX: *Hormaphis hamamelidis* (Fig. 2), greenish or reddish, on upper side of leaf; *Hamamelistes spinosus* (Fig. 3), green or reddish bud-galls.

**Tulip-tree**

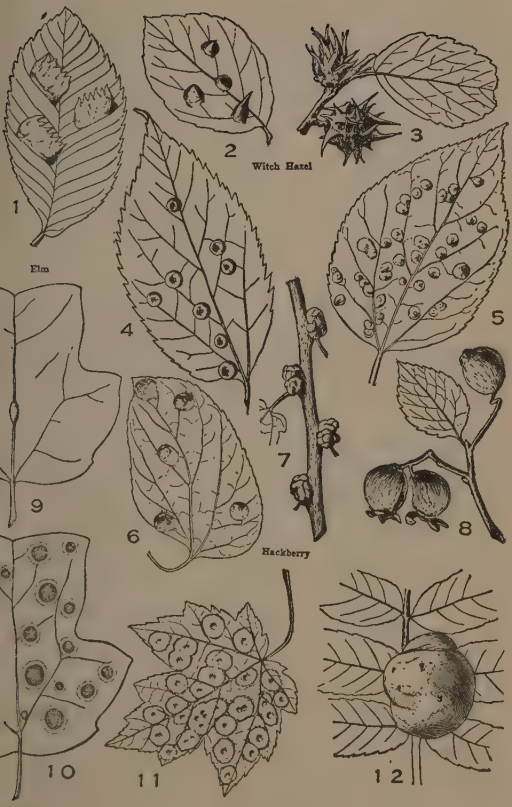
Plate XCIX: *Cecidomyia tulipifera* (Fig. 9); *Thecodiplosis liriodendri* (Fig. 10), brown spots with a yellow or greenish areola.

**Maple**

Plate XCIX, Fig. 11: *Cecidomyia* (?; incorrectly classed in *Sciara;* probably not a Mycetophilid, according to Dr. Felt) *ocellaris*, light yellow or green, usually with a red, central dot; it has never been reared. *Phyllocoptes acericola* make slender, spindle-shaped galls on the upper surface of sugar-maple leaves; and *P. quadripes*, small, bladder-like galls on the upper surface of soft-maple leaves.

**Sumac**

Plate XCIX, Fig. 12: *Pemphigus rhois*, yellowish-green tinged with red, hollow, on under side of leaf.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Elm
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Witch Hazel
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Hackberry
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Tulip-tree
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Maple
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Sumac

**Rose**

Plate C shows: *Rhodites bicolor* (Fig. 1), yellowish-green sometimes tinged with red in summer, brown in winter; *R. radicum* (Fig. 2), on root; *R. globulus* (Fig. 3), smooth, abrupt at ends; *R. dichlocerus* (Fig. 4), tapering at ends, reddish; *R. rosæ* (Fig. 5), mossy mass containing hard cells; *R. ignota* (Fig. 8), white-mealy surface, rather round, sometimes coalescing; *R. vernæ* (Fig. 7), reddish; *R. lenticularis* (Fig. 6), somewhat flattened.

**Raspberry**

Plate C, Fig. 9: *Diastrophus radicum*, especially on roots of black raspberry; varies from size of a pea to 2 x 1 inches.

**Blackberry**

Plate C: *Diastrophus bassettii* (Fig. 10), on the stems of trailing blackberry close to the ground; greenish, tinged with red, pithy with many rounded cells; *D. nebulosus* (Fig. 11), dark green, turning reddish; *D. cuscutæformis* (Fig. 12). *Lasioptera farinosa* makes an irregularly ridged, warty, light brown swelling, about half an inch long, on the under side of leaf-veins; *L. nodulosa*, an irregular, elongate swelling about an inch long on the smaller branches.

**Cratægus**

*Cecidomyia bedeguar* makes a tufted, nearly globular gall, about half an inch in diameter, on midribs; and *Hormomyia cratægifolia*, a cocks-comb gall on the leaves.

**Cinquefoil**

Plate C, Fig. 13: *Gonaspis potentillæ*, on axils of leaves, single-celled. Two species of *Diastrophus*, *niger* and *minimus*, make galls on the stems.

**Wild Cherry**

Plate C: *Acarus serotinæ* (Fig. 14), hollow, stemmed pouches, opening on under side of leaf; *Cecidomyia serotinæ* (Fig. 15), bright red in spring.

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Rose
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Trailing Blackberry
Blackberry
Black Raspberry
13
Cinquefoil
14
15
Wild Cherry

**Grape**

Plate CI: *Schizomyia pomum* (Fig. 1), variable, with 8 or 9 ridges when mature, numerous longitudinal cells each divided by a partition; *Cecidomyia viticola* (Fig. 2), green or red; *Lasioptera vitis* (Fig. 3), yellowish-green or reddish, on stems and leaf-stalks. *S. coryloides* makes a rounded mass, about 2 inches in diameter, of from 10 to 50 opaque, woolly, rather spindle-shaped, green galls. *Asteromyia petiolicola* makes spindle-shaped swellings on the petioles. For *Phylloxera vastatrix* see page 88; the leaf-galls are hollow, fleshy swellings, which are rather wrinkled and hairy, on the under surface of leaves, opening above.

**Touch-me-not**

Plate CI, Fig. 4: *Cecidomyia impatientis*, succulent, semi-transparent, containing a number of cells, at base of flower of *Impatiens*. *Lasioptera impatientifolia* causes a swelling of the base of leaves.

**Linden and Basswood**

Plate CI, Fig. 5: *Cecidomyia verrucicola*, wart-like, about a fifth of an inch in diameter, usually formed in July. *Cecidomyia citrina* deforms young terminal buds; *Eriophyes abnormis*, top-shaped galls on the under side of leaves.

**Dogwood**

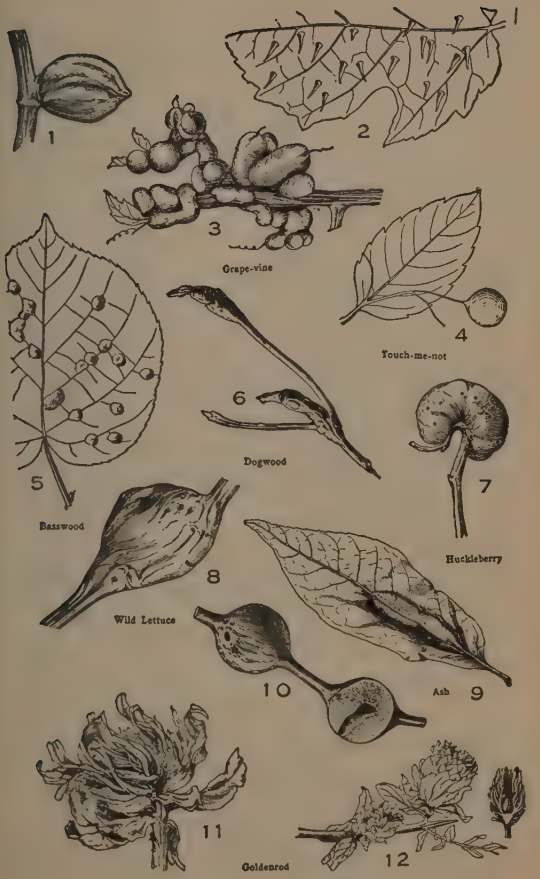
Plate CI, Fig. 6: *Lasioptera clavula*, contains an elongated channel inhabited by a single larva.

**Huckleberry**

Plate CI, Fig. 7: *Solenozopheria vaccinii*, on stems of *Vaccinium;* the illustration shows an old gall with exit holes.

**Wild Lettuce**

Plate CI, Fig. 8: *Aulax tumidus* varies greatly, on main stalk of *Lactuca canadensis*, often involving the flower-panicle.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Grape-vine
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Touch-me-not
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Basswood
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Dogwood
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Huckleberry
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Wild Lettuce
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Ash
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Goldenrod

**Goldenrod**

Plate CI: *Eurosta solidaginis* (Fig. 10 shows galls from which the flies have emerged), pithy inside with a rounded cell in the center on the main stalk; *Rhopalomyia solidaginis* (Fig. 11), caused by the arrest of stalk; *Œdaspis polita* (Fig. 12), caused by the arrest of side branches. *Lasioptera solidaginis* makes a gall much like that of *Eurosta*. Galls made by two genera of moths are often confused with these but, if the larvæ are present, one can at least determine whether or not they are Lepidopterous; to mention two species: the gall of *Gnorimoschema gallæsolidaginis* is about the size of *Eurosta* but is more tapering (adults emerge in September and hibernate), that of *Eucosma scudderiana* is merely an elongate thickening of the stem near the flower head (adults are found from June to August, larvæ or pupæ hibernating). The aerial gall of *Rhopalomyia hirtipes* is a large swelling of a bud "resembling a dried prune in texture; hard center"; it also makes a subterranean root-stalk swelling. *R. fusiformia* causes a ribbed, elongate structure, about a quarter of an inch in length, which occurs singly or in masses on the stem or foliage. Species of *Asteromyia* live mostly in galls, which are apparently affected with fungus; *carbonifera* causes a black blister and *rosæ*, a rosy one; similar galls occur also on asters. About 150 kinds of galls have been recorded from American Compositæ.

**Ash**

Plate CI, Fig. 9: *Contarinia canadensis*, succulent, pale green and sometimes tinged with red, formed in May or June. *Eriophyes fraxiniflora* deforms the catkins; and *E. fraxini* makes numerous galls on a single leaf, wart-like, subdivided by irregular, hairy curtains within. *Dasyneura tumidosæ* causes a gall much like *pellex* but on the base of the midrib and apical part of the petiole.

In closing, permit me to request that, if errors are detected among the thousands of categorical statements made in this book, they be brought to my attention. If portions are not clear or if you desire further information, I shall be glad to do what I can to help you. It is for such a service, among others, that the American Museum of Natural History, New York City, exists.

# HABITAT AND PLANT INDEX

It is hoped that the following index will be useful, but it gives only hints. For example, in the matter of food: Many larvæ feed on a wide variety of plants; it would be out of the question to list them all. Roughly grouping by habits and habitat the insects mentioned in this book, notice:

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For some of the general feeders on orchard trees see pp. 82, 85, 93, 105, 140, 168, 194, 201, 219, 310, and 338; on shade trees, 82, 93, 176, 194, and 219. The following are the principal references to special plants eaten by insects:


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